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CHEMICAL & METALLURGICAL ENGINEERING

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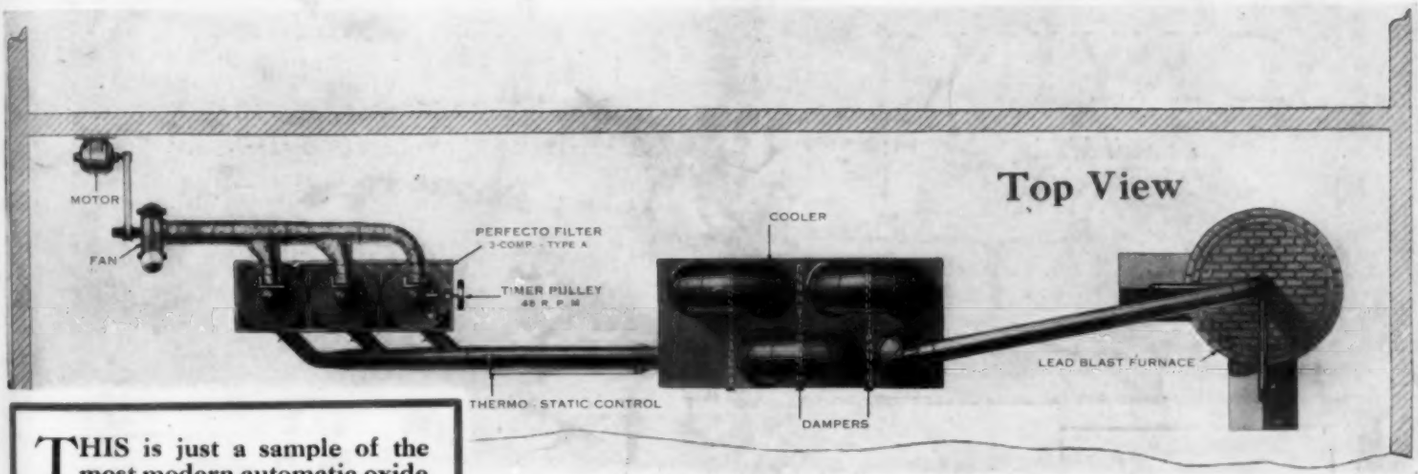

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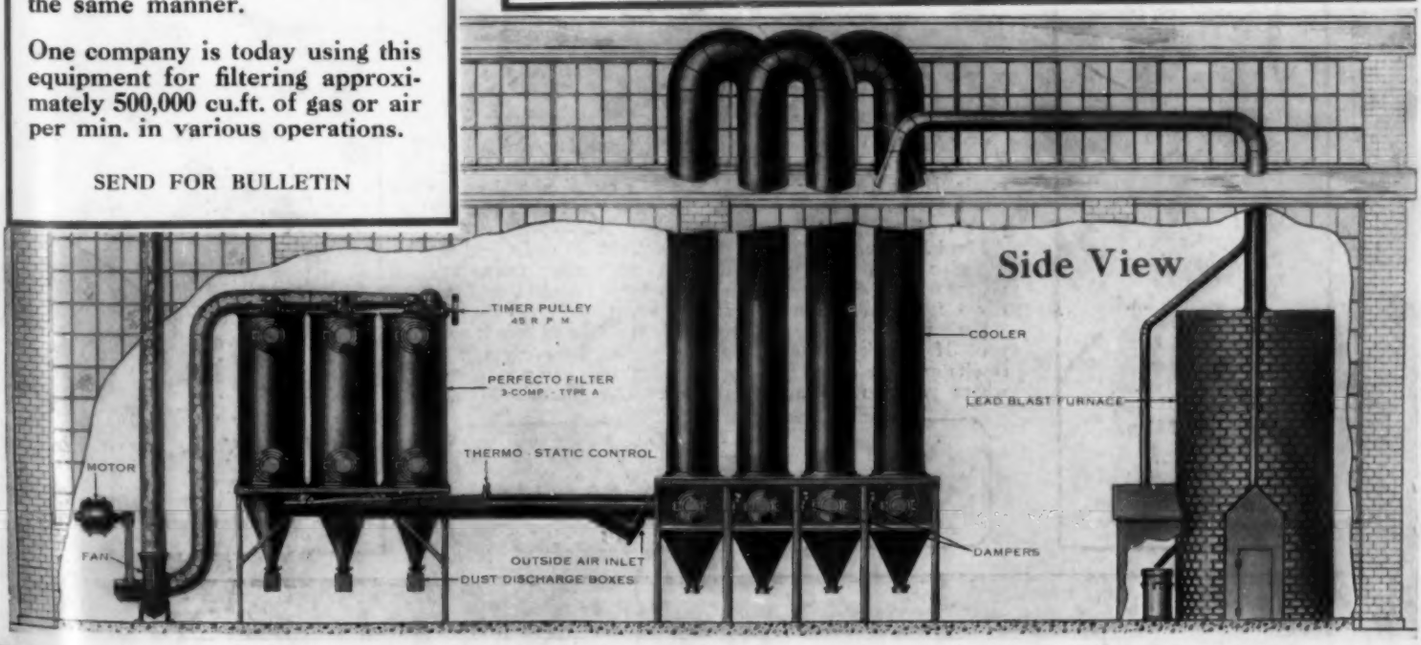

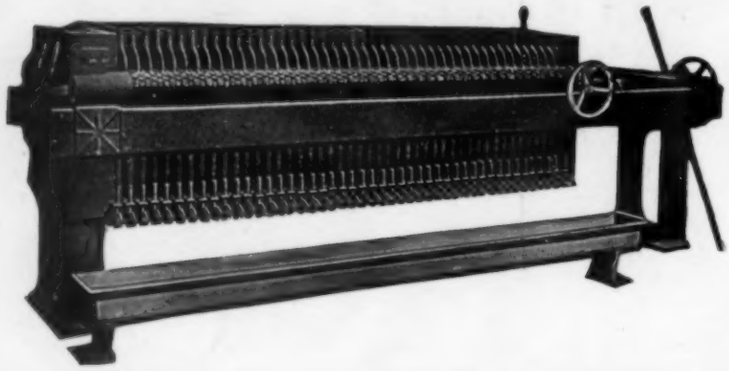

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CHEMICAL & METALLURGICAL ENGINEERING

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Editor

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Chemistry in the Service of the State

INTERPRETING chemistry, demonstrating the rôle of chemistry in the march of civilization and recounting to the layman the achievements of chemists and chemical engineers are propaganda of a helpful and stimulating character. Much has been done in recent years toward instilling in the public mind a respect for the influence of chemistry and in inculcating an interest in things chemical among the young. Educational institutions are well equipped for such work, and we commend the excellent booklet, "Chemistry in the Service of the State," issued recently by the department of chemistry, University of Wisconsin. It contains all that is needed to attract the attention of the "man in the street" to the work of chemists and the influence they have exerted in raising the standard of living, insuring comfort and independence from ills formerly considered as inevitable "acts of God," and pointing in no uncertain manner to the possibilities of the future if the art be given adequate support and encouragement. Of particular pertinence at the present time is the championing of pure science, for the development of which "the investigator is primarily interested in the discovery of new principles and new facts, regardless of any chance practical application they may prove to have. . . . The industries must turn to the investigator for the basic scientific research which is the foundation of modern industrial processes." It is indeed true that the "university which contents itself with the mere teaching of facts cannot hope to compete for long with the university which has on its staff men of real creative ability, who are continually adding to the sum total of human knowledge." The example of such men, it may be added, is of considerable value to the student: he is taught the importance of systematic thought.

As the research worker must build on the discoveries of others, so a story of chemistry must start with historical references to its early growth and struggles. Exactness, the keynote of chemistry, may be said to have originated with Lavoisier, complex synthesis with Wöhler. The tree of chemistry now has so many branches that its influence penetrates into every phase of human activity, industrial and social. "Chemistry in Agriculture," "Chemistry in the Industries," "Chemistry in Disease"—these are a few of the subjects of compelling interest to the layman, if the message can be "put over." The Wisconsin booklet will do much good, and we trust that the example will be followed. Its pages reflect the cultural value of chemistry, which it advocates; for, although written in popular vein, the English used is impeccable. The selection of chemistry as a basic educational subject for the majority of university students is as logical as it is eventually inevitable.

City Gas As a Fuel

ELSEWHERE in this issue appears an article by Prof. D. J. Demorest discussing the economic side of the use of city gas as an industrial fuel. The timeliness of this paper, coming as it does when there is much activity by gas manufacturers looking toward the extension of their sales in industrial heating, is evident. With so much pressure being exerted from the seller's side, it is well for the prospective buyer to get as many of the facts in the case as he can from an outside and impartial source.

In any heating problem, three primary factors, as well as certain secondary factors peculiar to the particular work to be done, must be considered. These are the cost of the heat in some such unit as cents per million B.t.u., the efficiency of the fuel, and the effect of the heating method on the product. It is undoubtedly true that city gas is an almost ideal fuel from the standpoint of quality of work, as it is also from such secondary considerations as ease of handling and control. It is not, however, as economical as are some other fuels when considered on the B.t.u. or efficiency bases. Also, the secondary factors will all have a certain weight in reaching any decision as to what fuel to use. While we wish to affirm our belief that city gas is an ideal fuel for many heating operations and could well be used more widely than it now is, it still seems well to insist that full consideration should be given to all the influencing factors and that the fuel should not be adopted, as is so often done, on the basis of the secondary consideration of convenience alone.

C.W.S. Policy Is Vindicated

REAPPOINTMENT of General Amos A. Fries as chief of the Chemical Warfare Service of the United States Army is a well deserved recognition. But it is more than this. It is a vindication of the aggressive and progressive policy which this able officer has instilled into this new scientific branch of the military establishment.

The work of the C.W.S. has been difficult in the extreme. Starting with the feeling of public horror and opposition to anything that savored of the German type of chemical warfare, this new branch of the army undertook to find for itself the proper place in our military scheme and to demonstrate to the American people that good sense and civilized rules of warfare were in nowise offended by proper chemical preparedness. Except for the fact that the C.W.S. is still not adequately recognized in our military and naval program, the achievements accomplished under the leadership of General Fries are notable.

The reasonableness, indeed the necessity, of being

ready for offensive chemical attack has been demonstrated to the satisfaction of the American people, taken as a whole. This does not mean that either the American people or the C.W.S. officers believe that we should plan offensive "poison gas" measures. But an understanding of every such measure as might be used against us and the preparation for adequate protection against it is clearly demanded.

An impartial survey of the situation, if made by those not too long prejudiced by use of *old* military weapons, would probably indicate that 2 to 3 per cent of the total expenditure on military preparations should go into training, materiel and research for chemical warfare. At present only a small fraction of 1 per cent of our military expenditure is so applied. The inadequacy of the present total is to be regretted, yet the recognition of the Chemical Warfare Service by the reappointment of General Fries is a matter for self-congratulation by the chemical profession and the chemical industry.

Let the good work go on!

Getting the Grouch Out of the System

INVENTIVENESS connotes thought, even abstraction. The inventor is often a mentally alert individual, given to introspection and critical analysis, characteristics that sometimes lead to the development of what is known as "temperament." He carries his work to a logical and scientific conclusion, and often wonders why it attracts so little attention, forgetful of the fact that he has probably concentrated for several months on a problem to which others have given but a few moments' attention. Occasionally he gets a "raw" deal from his principals. This is apparently inevitable. The modern business structure is a variegated edifice of complexities. The directing head cannot attend to details, the management of which is usually deputed to subordinates. In most instances these are honorable gentlemen. Occasionally, however, one rung in the ladder of promotion is occupied by an official of distorted vision, who can at one and the same time smile at those ahead and scowl at those below. To him, inventiveness is a form of initiative that is born only to be squelched out of existence by persistent discouragement. He finds in the restricted technical knowledge of his chief an attitude that welcomes conviction as to the futility of research. The inventor becomes discouraged, and sometimes quits the race; the executive's lieutenant "sits pretty."

If, gentle reader, you are among the victims, we can sympathize, for we have seen the tragedy enacted in many forms and under widely varying conditions. The first effort toward improving conditions should be to get rid of the grouch by diversification of interest. Plenty of problems are awaiting solution, and if you have trained yourself to think and reason, the most important item of equipment for the research worker is at hand. However much you protest that you will forswear interest in what is unknown and untried, and even though you promise yourself relaxation to the humdrum existence of the man with an allotted task, your resolutions will break like piecrust. As the murderer returns to his crime, so the inventor is drawn irresistibly back to inventive work.

Many a grouch is justified, but unfortunately most of them spring from irremediable causes. An unscrupulous industrialist, by devious machinations, may rob the inventor of credit or reward; but he cannot rob him of his intellect, or deprive him of the sharpness of mentality induced by inventive effort.

Trend of Development in Continuous Thickening

FOR a great many years the advantages of continuous methods in thickening and dewatering have obscured the question of efficiency of result, in so far as the density of the underflow product was concerned. And it is strange to realize that so long a period elapsed before a serious attempt was made to combine gravitational thickening with the application of pressure or vacuum in the development of a machine to operate on the continuous principle, or to use vacuum or pressure alone for this purpose. Recently, however, marked interest is noticeable in this phase of unit-process engineering, and numerous adaptations of the underlying principle are being evolved.

A pressure filter is necessarily intermittent in operation. As an alternative, attention was paid to the possibilities of vacuum in place of gravitational thickening in the separation of valuable liquor from valueless residue. The drum filter was the most significant development in this direction, followed by the disk filter—machines that have found wide application as dewaterers in the chemical and chemicometallurgical industries. Efficient operation, however, is dependent on the provision of a feed of adequate density, obtainable usually by preliminary gravitational thickening. The use of vacuum, however, for straight dewatering, is expanding rapidly. In machines of the Oliver-Borden and Gunter type a cake is formed on small filter cylinders and discharged at intervals, through the pulp in the tank, toward the sludge exit at the bottom. A continuous delivery of product is therefore obtained by the utilization of intermittent methods of cake formation—an ingenious development.

Among thickeners utilizing gravity as well as vacuum, perhaps one of the most interesting is that developed by A. L. Blomfield and proved in Colorado. The bottom of the tank is provided with a porous support, usually miscalled a filter bottom, on which a deep layer of sand is placed and through which solution percolates. The thickener is equipped with a ribbon spiral scraper, which continuously moves settled material toward the exit at the center of the tank. To assist the thickening process, the solution underneath the porous support is discharged through a gooseneck at a point near the top of the tank so that a slight suction is created underneath the sand. A cake of material is thus formed continuously, to be removed almost immediately by the spiral ribbon scraper. To insure efficient dewatering, the mechanism operating the spiral is arranged automatically to lower itself into the sand and thereby to scrape sufficient of this at each revolution to insure a clean bed. The rate of filtrate flow is therefore kept at a maximum, with minimum pressure requirements. This machine has found application in cases where the contamination of the thickened product with a small amount of sand is not detrimental; or a coarse product of the same nature as the fine material to be thickened may be used as a filter aid.

The Blomfield machine is a development of the idea

underlying the Blaisdell excavator, as applied first to the discharge of drained sand through a central exit of a circular vat provided with a porous bottom. A ribbon spiral is used instead of the disks, however, Blaisdell's task being to plough as quickly as possible into the settled mass, and move it at the same time toward the center, whereas the Blomfield machine handles a product that can be moved easily by scraper. Here the analogy ends, however. But the Blaisdell excavator doubtless supplied the inspiration to many inventors of continuous machines designed to receive a thin pulp and deliver a thick discharge. The Blaisdell patent, it is understood, was purchased before its expiration by A. E. Vandercook, who developed a gravitational, continuous thickener, using the ribbon spiral for discharge.

The field existing for the development of gravitational-vacuum thickening devices is a promising one. Thickening in many of its applications connotes, as does filtration, a washing of the residue from associated solution. The efficiency of the whole operation will therefore depend largely on the degree to which thickening can be carried in each unit, without undue delay or expense. This point has received emphasis in the successful application of continuous filters, with pulping between units, as countercurrent washing machines. The Blomfield idea has much promise, and it is not unlikely that future developments may lead to the evolution of a successful machine in which thickener underflow need not be contaminated with a granular filter aid. The Godbe thickener, with auxiliary cake formation around the sides of the tank, for which successful application is reported in gas-plant practice, is of this type.

Simplicity and Directness—The Essentials of Research

SCIENCE has often been associated with theorizing in hermit-like isolation and with the elaboration of research, in some instances for no other reason than to justify its continuance. Not long ago a comparison of two processes, devised to achieve the same result, was made. One of these was based on the application of simple though inappreciated fundamentals. It was demonstrated and applied at small expense, and served its purpose. The other attacked the problem from a different angle, found itself in difficulties, and had recourse to an exhaustive program of research, carried out at immense expense. Strange to relate, the complicated process, which achieved no more than did the simple process, was lauded by its sponsors as a scientific accomplishment, in invidious contrast to the more economical process, which was based on what Huxley would have termed "organized common sense." Apparently the only justification for the conclusion was based on the fact that the development of the complicated process had necessitated a small army of scientists before any result was secured.

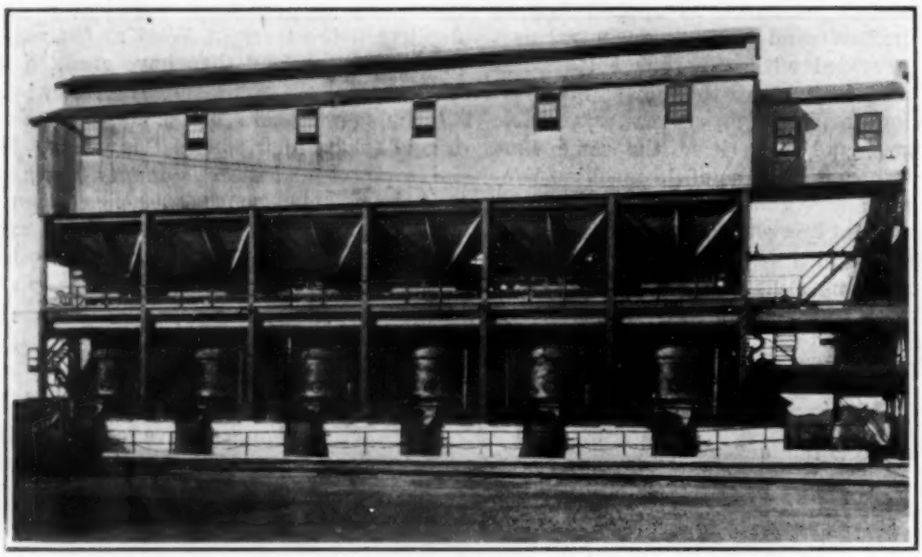
According to the ideas of some super-degreed and high-salaried individuals in charge of the best equipment that money can buy, James Watt, inventor of the condensing steam engine, was the veriest "piker" in scientific research. Nevertheless, he was a pioneer, who could think in terms of practical application and "get there" without the aid of unlimited funds and the moral support that money can buy today. We call to mind more than one research organization that might have duplicated the work of Watt at the expense of several million dollars, and then have credited its achievement as the result of super-scientific knowledge and praiseworthy persistence, to the disparagement of the more frugal efforts of the humble inventor. Money is plentiful in places, and there is danger that a spurious science may be flaunted to the discouragement of simplicity, economy and directness. The best safeguard is the common sense view of the practical scientist, in touch with both the laboratory and the plant.

The Scientologist—Bridging The Laboratory and the Plant

AMAZING changes have occurred in recent years in consequence of the invasion of Industry by Science. Until comparatively recent times the scientist, in the popular mind, was pictured as an individual who played with test tubes at odd moments to relieve eyestrain caused by the prolonged observance through the microscope of the antics of animalculæ. He was considered as a being apart from ordinary mortals, unpractical and visionary. The stress of competition has changed all this. Science today is the helpmeet of Industry; and the scientist who hopes to "arrive" must have for his purpose in life the introduction of changes that will speed production, reduce costs and improve quality; he must devise applications and perfect processes for the utilization and conservation of resources and manpower; he must benefit Industry and, in doing so, benefit humanity. This consummation of ideals may not be his immediate objective, but it indicates the purpose of his work. He cannot dissociate himself from the ultimate object, although this must not be allowed to influence actions or deflect the course in the direction of the scientific ideal—the discovery of fact.

The gap between the laboratory and the plant has narrowed so much of late that a bridge between the two is possible, whereby the scientist can emerge from his seclusion and, seeing the application of his researches, take a scientific interest in production problems. With a closer acquaintance with these he becomes "practical"; and in due course, with official recognition of his ability, he takes charge of the plant. Variations in application occur, but this is the skeleton of the idea that has found favor and that pays dividends. Science has invaded Industry.

Radical innovation prompts consideration of the inadequacy of existing nomenclature. New words are added whenever emergency exists. They are justified by usage, become current coinage and in time are accepted as "good English." The scientist, the dictionary tells us, is one "learned in science." The technologist is one "skilled in technology," which is science applied to industry. With the blending of the two avocations, as observable in hundreds of industrial plants today, a need arises for a new designation. A "scientologist" is the type of man we mean. He is a real live wire—we have often wanted to describe him with one word—up to the minute in theoretical knowledge, coupled with an appreciation of actual operation that makes him the keystone of the arch of Industry; able to direct research in the laboratory as well as to supervise the design and operation of equipment to put the results of such research into effect.



Battery of Eight Koppers-Kerpeley Producers That Turn Out 33,000,000 cu.ft. every 24 hours

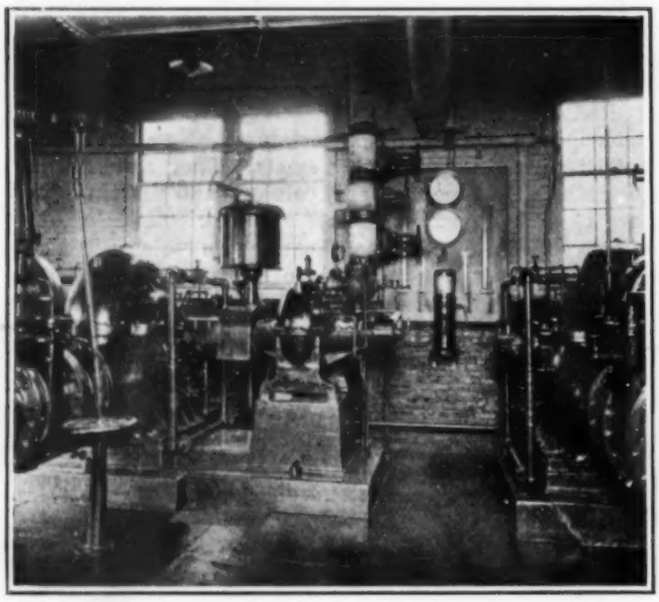
Gas Producers on a Large Scale

SINCE the recent great increase in the use of byproduct coke ovens as a source of gas for domestic and industrial fuel, the heating of coke ovens by some other fuel than coke-oven gas has commanded much attention. The profits to be made from the sale of the gas from the ovens made it advisable to obtain a cheaper gas for this heating operation.

One of the solutions reached is well illustrated by the battery of gas producers of the Koppers-Kerpeley type installed at the plant of the Seaboard By-Products Coke Co., Kearny, N. J. This plant, consisting of six producers and necessary auxiliary equipment, gasifies 230 tons of coke daily and produces from this 33,000,000 cu.ft. of gas, the greater part of which is employed for fuel in the coke-oven heating flues.

The producers are of the revolving grate type with eccentrically placed cone-shaped grates, which, in revolving, continually remove the ash. The lower half of each unit is surrounded by a water jacket that is connected to an overhead steam drum. This constitutes a low-pressure boiler of sufficient capacity to furnish the steam for blasting the producer fuel bed. The gases leaving the producers pass through waste heat boilers that generate enough high-pressure steam to operate the blowers for the air blast and the exhausters that serve to remove the producer gas from the producers.

These producers are under rigid control. The coke is weighed into the feed hoppers, the air supplied to each producer is measured by an orifice meter and the temperature, volume and heat value of the output are continuously recorded. As a result of steady running under approximately test conditions, 80 per cent of the B.t.u. supplied to the producers in the coke is obtained in the form of clean, cold producer gas. This is an efficiency in the production of a fuel gas that can be piped and used where desired that is worthy of attention from other plants besides byproduct coke ovens.



Producer Exhausters and Control Instruments

Charging Floor Above the Producers

When Can City Gas Be Used for Domestic and Industrial Heating?

The Economic Factors Controlling the Use of Coal Gas and Coal Gas-Water Gas Mixtures in House and Factory Furnaces

By D. J. Demorest
Professor of Metallurgy, Ohio State University

COAL is merely the greatly altered organic matter of the swamp vegetation of ancient geologic ages with which there has become mixed such inorganic substances as quartz, feldspar, pyrite and kaolin, carried into the swamps by water and deposited partly by settling and partly by precipitation. Ash from coal is made up chiefly of these minerals, and when coal is distilled in closed retorts to gasify the carbon, they remain with ungasified carbon in the coke. The organic matter of coal, chiefly carbon, nitrogen, hydrogen and oxygen, passes off when coal is distilled, partly in combinations and partly, except the carbon, in the free state. But all coals contain more carbon than can enter into these combinations. It is this excess carbon, combined with ash, that forms the residue or coke, generally about 70 per cent by weight of the original coal.

This process of destructive distillation or carbonization of coal to make coal gas is carried out commercially in several different types of closed retorts, roughly classifiable as horizontal and vertical retorts and coke ovens. These retorts or chambers are made of silica refractories. They are heated on the outside by burning gas around them. The heating gas used is usually producer gas, the producer sometimes being part of the setting, but in the larger plants being in a separate structure. In all modern plants the hot products of combustion, after having given up as much of their heat as possible to the retorts, pass through regenerators or recuperators in which a part of their heat is used to heat the incoming air and gas, thus saving heat and reducing the amount of gas necessary for heating the retorts. In some modern plants the products of combustion pass through waste heat boilers, there raising sufficient steam, from otherwise waste heat, to take care of all plant needs.

The result of all this careful saving of heat is that it takes only about 300 lb. of nearly unsalable coke breeze to carbonize a ton of coal in such a plant as a modern vertical retort installation. The net result of such carbonizing per ton, after deducting the breeze used for heating, is as follows: 11,000 cu.ft. of gas of 535 British thermal units per cu.ft. average, 1,050 lb. of coke, 100 lb. of tar, 3 gal. of light oil, 5.3 lb. of ammonia. Before the gas can be used, however, it must be cleaned and purified and the byproducts removed. To do this it is necessary to cool the gas to condense the tar, then to scrub it to remove tar vapors that will not condense, then to extract the ammonia, then to scrub out the light oil and finally to pass it through purifiers for removal of as much of the hydrogen sulphide as possible.

The exact composition of coal gas so made and purified varies with the coal from which the gas is made and the type of plant used. A good average would be: CO_2, 2.1 per cent; C_2H_4, 3.8 per cent; O_2, 0.5 per cent; CO, 8.0 per cent; H_2, 47.8 per cent; CH_4, 26.4 per cent; C_2H_6, 2.0 per cent; N_2, 9.4 per cent; and the sulphur would be 20 grains per 100 cu.ft., while the average heat content would be 545 B.t.u. gross value.

Such a gas, reasonably free from sulphur, is an ideal fuel. As shown by the curves in the previous article on blue water gas (*Chem. & Met.*, vol. 31, No. 23, Dec. 8, 1924, p. 887), its temperature of combustion and flame efficiency are very high—nearly as high as for blue gas—and the heat content is nearly twice as high as that of blue gas. This makes it possible with coal gas to transport a larger amount of potential heat in a given main and at a given pressure than with water gas. There is no industrial or domestic heating that it will not accomplish as satisfactorily as any other gaseous fuel except welding, for which blue gas is perhaps better because of its freedom from soot. Like water gas, its rate of combustion is fast, so that it gives a short, intense flame. The only limit to its application is cost. For instance, while it can be used in reverberatory furnaces, if the burners are specially designed to keep such a low specific gravity gas off the roof, such a practice would be economical only where there is no demand for city gas.

The process of making coal gas is a complicated one, requiring an expensive plant and skilled attention. As would be expected, the capital charge for coal gas manufacture is high as compared with that of, for instance, blue water gas. The investment cost per thousand cu.ft. is about twice as high for coal gas as for blue gas.

In the two previous articles of this series the characteristics and economical utilization of producer gas and blue water gas were discussed. The gas producer gasifies all the carbonaceous matter of the coal, leaving only ashes; 135,000 cu.ft. of gas per ton of coal is produced, having an average heat value of 150 B.t.u. per cu.ft. High efficiency (90 per cent), when making hot gas, is good operating practice. The blue gas generator gasifies only the carbon of the coke or anthracite used, producing per ton of fuel about 55,000 cu.ft. of 300 B.t.u. per cu.ft. gas. On the other hand, the coal gas process, by breaking up the organic matter of the coal, yields a smaller quantity, about 11,000 cu.ft. per ton of coal, of a high-grade gas and leaves coke, tar and ammonia as byproducts.

However, per therm (100,000 B.t.u.) the investment cost for coal gas is only slightly greater than for blue water gas, being about 2.8 cents and 2.4 cents respectively, based on the assumption that the plant runs to capacity throughout the year, which it never does. The above costs are based on the assumption of 12 per cent of the investment covering interest, depreciation, etc., which is rather low. Also, a large-scale plant is assumed.

When coke is obtainable at a fairly low price, a coal gas plant would not be as logical an installation for purely industrial purposes as a blue water gas plant, for blue gas is in every way as satisfactory as coal gas for industrial purposes and the capital cost is much less. If the gas is to be used, however, in a locality where coke is costly, then the most economical procedure would probably be to erect a coal gas plant just large enough to furnish coke for a water gas plant, the two in combination producing the required supply of gas. Except in coke works, operated primarily for coke production, it is rare that coal gas is used alone on a large industrial scale.

Coal gas is, however, the most frequently encountered city gas. For this purpose it is entirely satisfactory. Except in small towns it is likely to be mixed with water gas, as mentioned above.

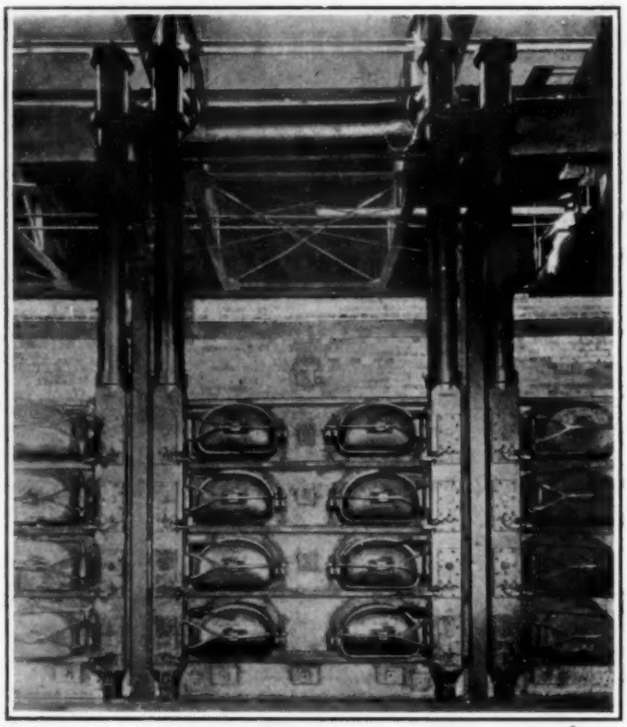
For each ton of coal carbonized there is about 11,000 cu.ft. of gas and 1,000 lb. of salable coke. About 350 lb. of small coke is produced in addition that is not readily salable, but can be satisfactorily used to make producer gas for heating the coal gas retorts. It is then to be decided how to use the 1,000 lb. of good coke most profitably. It can be sold for domestic heating or industrial heating, or it can be used to generate blue water gas. The decision rests on a compromise depending on the following considerations:

1. The capital required for 1,000 cu.ft. of coal gas making is approximately twice that required for 1,000 cu.ft. of blue water gas making. On the therm basis the coal gas requires 15 to 20 per cent more capital than the blue gas.

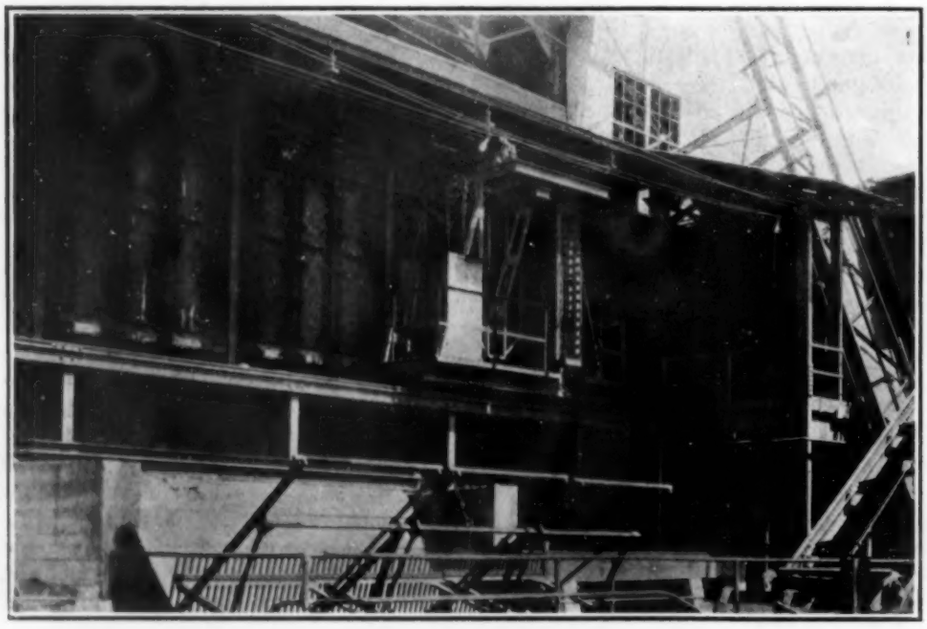
2. If the market for coke is good, with a high price, it will probably be more profitable to sell the coke than to convert it into blue gas and sell that, for each dollar of increase in the value of coke per ton increases the production cost of blue gas about $0.02 per 1,000 cu.ft.

3. As the price of coke recedes, the cost of coal gas manufacture goes up, coal prices remaining the same, and the cost of blue gas manufacture goes down, because one of the chief credits to the coal gas process is from the sale of the coke. The income from coke sales is about one-half the entire manufacturing cost of coal gas when the net sale value of the coke is $2 per ton greater than the cost of coal.

4. Owing to the greater first cost of a coal gas plant



Bench of horizontal coal gas retorts at Laclede Gas Light Co., St. Louis, Mo., showing scrubber standpipes between rows of retorts, through which the gas passes upward to the collecting main shown along top of picture.

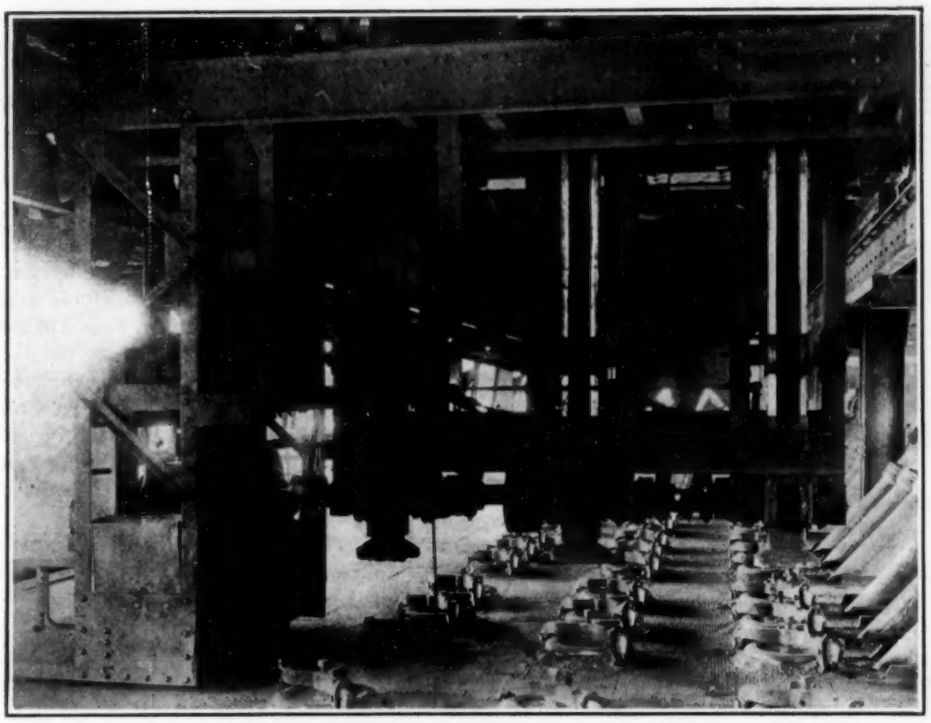


Coke oven plant of the small city gas oven type located at Quincy, Ill., showing coke guide and door-handling machine in front of ovens, coke wharf at bottom of picture, producers for generating oven-heating gas at right and coal-handling equipment above.

as compared with a blue gas plant, it is less costly to allow the latter to stand idle. Since the demand for gas is greatest in cold weather, it is inevitable that a plant built large enough to meet the winter demand should be partly idle in summer.

5. It takes many days to place coal gas retorts in operation, while a water gas set can be put in operation in a few hours. Hence it is necessary, if maximum economy of operation is to be realized, to have a water gas set available to take up the load when a sudden increase in demand for gas occurs.

As a result of these considerations and other practical facts such as the difficulty of obtaining capital, municipal regulations concerning gas standards, etc., a large city gas plant will probably be built as follows:



Top of a battery of vertical coal gas retorts, showing charge ramming machine in position with offtakes at the right and lorry car just visible behind the ramming machine.

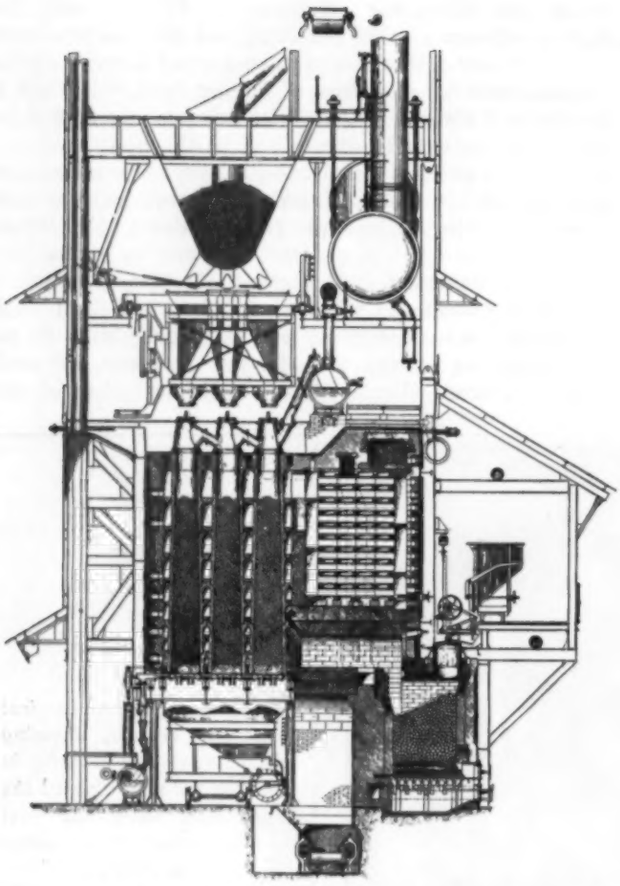
A coal gas plant of sufficient size so that it can be operated at about full normal capacity throughout the year without an oversupply of gas at any time. A water gas plant auxiliary large enough, taken in conjunction with the storage capacity of the gas holders, to take care of the peak demands on the plant. In addition, the mixed gas so made will have to be enriched by the addition of natural gas or oil gas to an amount depending on the proportions of the water gas-coal gas mixture and the B.t.u. standard for gas in the locality.

This B.t.u. standard is at present tending toward lower levels, because the gas works can supply more heat for the customer's dollar in a low B.t.u. gas than in a high one, while still supplying a satisfactory domestic fuel. The lowest limit of the B.t.u. value of a gas that may be economically put into city mains is reached when the increasing cost of transmitting a therm in a lower B.t.u. gas overcomes the saving made in making the lower B.t.u. gas. The whole question hinges, however, largely on the market for coke. It is likely that coke will increase in popularity as a domestic fuel, for it is sootless and is ideal for firing hot water heating systems. One ton of coke when converted into blue gas and burned in an efficient domestic furnace will yield to the house about 11,000,000 B.t.u., with the water gas generator efficiency at 65 per cent, the furnace efficiency at 75 per cent, and distribution losses at 10 per cent. One ton of coke burned directly in the furnace with an efficiency of 30 per cent will yield to the house 7,500,000 B.t.u. With coke selling at $12 per ton, blue gas would have to sell to the householder at about $0.35 per 1,000 cu.ft. to give the same amount of heat per dollar cost, although the much greater convenience of the gas and the freedom from ash disposal would give the gas a greater comparative value than $0.35 per thousand. At Denver the gas company is finding it possible to sell gas of 380 to 400 B.t.u. at $1 per million B.t.u., or $0.40 per thousand plus a $9 per year customer charge and $21 per year per 100 cu.ft. hourly demand. Under these conditions 1 ton of coal at $11, without counting the cost of ash handling, has a cost per 1,000,000 B.t.u. of $0.89 as compared with the actual net cost for gas of $1.56 per 1,000,000 B.t.u. Perhaps the greatest difficulty in heating houses with low B.t.u. gas arises from the seasonal quality of the load, causing a large stand-by charge for plant idle in summer. The development of a summer gas demand (such as supplying refrigeration) is one of the greatest necessities if the cost of city gas is to be reduced.

Summing up all these considerations, the most economical city gas plant is one in which the coal gas part is of such size that its entire output of coke can be disposed of at the best price either through the water gas plant to the public as gas or direct to the public as coke.

Assuming that all these questions are settled and gas can be supplied at $1.75 per 1,000,000 B.t.u. through the city mains, what kind of industry can afford to buy city gas?

Any industry using a process requiring close temperature regulation such as bread baking, enameling or japanning can afford to buy city gas rather than to use coal because of the better quality of product obtained and of the much higher efficiency of the gas. It must be remembered that gas can and should be used



Section through bench of U. G. I. intermittent vertical retorts, showing producer, recuperator, coal handling, coke handling, collecting main and waste heat boiler.

with thermostatic control, which gives better heating and saves fuel as compared with non-thermostatic control. One million B.t.u. in gas at $1.75 per million B.t.u. when used at 75 per cent efficiency will yield as much heat to the operation as 200 lb. of good coal used at 30 per cent efficiency. If the coal is to cost the same per B.t.u. utilized as the gas, the cost of the coal would be $17.50 per ton, hence the gas cannot take the place of raw coal except when the coal is very high priced or other considerations govern. These other considerations are labor, uniformity of temperature and accuracy of temperature control, cleanliness, high temperature and ease of application. These considerations are so important that many operations now using solid fuel would be operated more cheaply if city gas were used. Gas is more efficient than oil on small operations. Even for annealing steel castings, it has been found that, on a B.t.u. basis, gas is 100 per cent more efficient than oil. On this basis a gallon of fuel oil of 130,000 B.t.u. heat content would have to cost 15 cents to make a B.t.u. cost the same as a B.t.u. from city gas at $1.75 per million B.t.u. It is, however, more trouble to use oil, which would increase the cost as compared with gas.

It must be kept clearly in mind by anyone who has the problem of deciding what kind of heating to use in any given process that the real problem is not the cost per B.t.u. but the cost per unit of product. In other words, the factors of fuel efficiency and quality of product are just as important items in the selection of a heating process as is the fuel cost per B.t.u. Whenever there is a difference in the physical or chemical nature of the fuel or in the mechanical equipment using the fuel, there must be a difference in the economic value of fuels regardless of their relative thermal values. In another article, to be published later, the relative values of various fuels will be given—as near as these can be calculated—and the manner in which special considerations must be evaluated to make such calculations of relative values usable with any degree of accuracy will be indicated.

Finally, it should be emphasized, when considering city gas as a source of heat, that in the past this gas has been thought of largely as a medium used for lighting and cooking. It is only in recent years that the use of city gas for general heating purposes has been actively considered. Since, however, both the gas companies and the city authorities are coming to realize that if the gas companies are allowed to transmit gas which is the cheapest per million B.t.u. for the consumer, then the economic standing of city gas takes on a new aspect and it becomes a factor in both the domestic and the industrial heating situation.

Glucose and Alcohol From Wood Waste

As a result of an observation of the action which took place when a wad of moist cotton was used as temporary stopper for a bottle of concentrated hydrochloric acid, there has recently been put in operation at Los Angeles a plant designed to treat 20 tons of wood waste per day for the production of glucose. Dr. R. A. Kocher described the process recently before the Southern California Section of the American Chemical Society and told how preliminary experiments showed a 60 per cent conversion of moistened sawdust into glucose after 24 hours exposure to hydrochloric acid gas.

In the plant, dried sawdust passes continuously through a series of four jacketed screw conveyors separated by ingenious seal valves that permit the use of varying pressures in the different units. In these, the wood is saturated with hydrochloric acid gas, heat of reaction being partly absorbed by cold water in the jackets so that the sawdust leaves the last vessel at about 50 deg. C. It then passes, via another seal valve, to a converter, in which a pressure of 2 atmospheres is maintained, with temperature at 50 deg. From this the mass passes, via seal valve, to another closed vessel, or evaporator. This vessel is constructed of cast iron, and no corrosion occurs, the interior surface being heated with steam. A vacuum pump is connected; and when the mass reaches the discharge it is almost free from acid gas, the final traces of which are removed by live steam applied in a conveyor vessel similar to those used in the preliminary stages of operations. The removed gas goes to a condenser, thence to conveyor vessel No. 2. Make-up gas comes from a generator of ordinary design. The cycle of treatment takes 1¼ hours, and the product is ready for packing and distribution as cattle feed. The process and apparatus are controlled by basic patents in the United States and foreign countries, owned by the Kocher Co., Inc.

For the manufacture of alcohol it is necessary to neutralize the last trace of acid, and this is done with lime. The glucose obtained by the Kocher process is 80 per cent fermentable, with the production of 65 to 70 gal. of ethyl alcohol per ton of sawdust, as compared with 50 gal. obtained from the treatment of 1 ton of straw.

Making Shale Oil in California

An Internally Heated Retort Is Being Used Successfully at the 40-Ton Plant of the N-T-U Company

By George W. Wallace
Consulting Engineer, San Francisco, Calif.

IN THE spring of 1922 an experimental plant was built in Santa Barbara County, California, to develop and perfect a process utilizing internal combustion for the distillation of oil shale. It was thought that many of the costly features connected with externally heated retorts could be eliminated if proper control were secured in the application of direct internal combustion to a body of shale in order to bring about the production and distillation of the shale oil.

This experimental plant consisted of a steel shell 8 ft. in diameter and 24 ft. high, lined with brick, and is called a generator in contradistinction to externally heated retorts. This chamber, or generator, holds a charge of 20 tons of shale. The outlet for the oils and gases is located at the bottom of the generator and connects with a fan type gas exhauster on the suction side.

The generator is charged with shale and ignited at the top. By a down draft through the column of shale a zone of combustion is set up at the top of the column of shale. The products of combustion in traveling down through the shale maintain a zone of distillation which travels progressively downward from the top to the bottom of the chamber below the fire.

The oil as it is produced from the shale either condenses in the cool shale underlying the zone of distillation or is carried by the gases to the usual standard condensing and scrubbing apparatus, where it is recovered and added to the oil condensed in the generator and pipe lines.

The air used to maintain combustion is modified by returning some of the gaseous products of combustion from the outlet of the last scrubber, thus reducing its oxygen content and thereby lowering the temperature of the zone of combustion. By thus modifying the air used fo rcombustion ,complet econtrol of the apparatus is secured and it is found that a zone of distillation can be maintained and caused to travel progressively downward through the shale at a considerable distance below the fire. The time required to complete the distillation is approximately 18 hours.

It is virtually impossible to subject the oil to a temperature higher than that of its formation, which is approximately between 700 and 800 deg. F., as the oil produced is immediately brought in contact with the cool shale underlying the zone of distillation. The extent of this protecting action can be better understood from the following temperature record:

Duration, Hr.	Temp. Below Grade, Deg. F.	Duration, Hr.	Temp. Below Grade, Deg. F.
2	148	14	166
4	152	16	220
6	154	18	400
8	160	20	897
10	160	21	1191
12	160		

This experimental generator was operated over a period of 12 months, during which time the process was subjected to a thorough study.

The cost summary in Table I is an average of 30 days operation of the experimental generator and should be compared with the costs secured operating the commercial unit.

This summary shows that virtually all of the excessive labor and expense in operating this experimental generator was incurred in the transportation and crushing costs and in the cost of discharging the apparatus.

As a result of the experimental operation a commercial unit was designed and built. This unit was so arranged and equipped as to minimize the items of cost which were found to be excessive in operating the experimental plant. Figs. 1 and 2 show this commercial

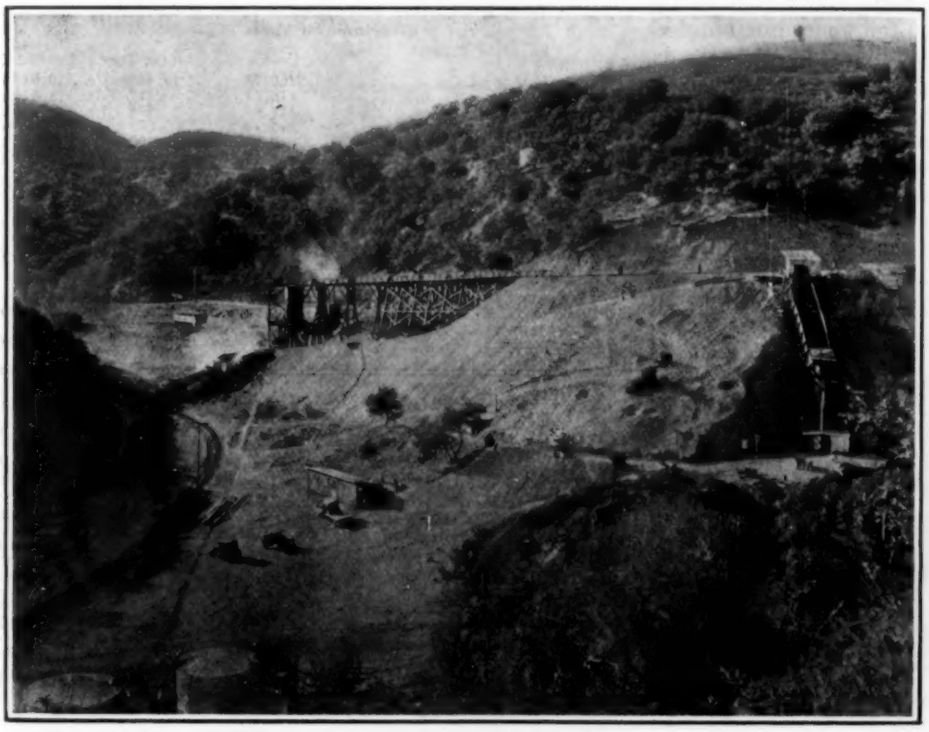


Fig. 1—A Distant View of the N-T-U Plant at Santa Maria

At the right may be seen the experimental plant, which had a capacity of 20 tons per day. Here the process was thoroughly studied before the 40-ton unit shown at the left was constructed. The retort is charged from above and the spent shale is wasted over the bank or hauled to the shale dump in the steel car shown at the extreme left.

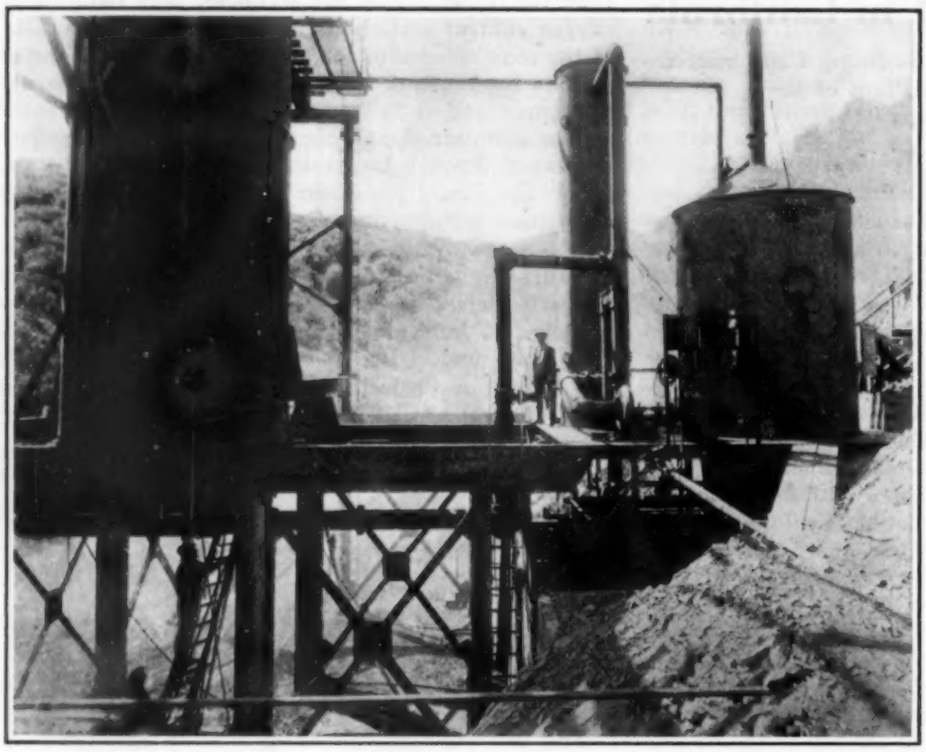


Fig. 2—A Nearer View of the 40-Ton Unit

The condenser, scrubber and the exhauster are to be seen at the right of the retort. The gas line for returning the products of combustion to the air inlet at the bottom of the retort is also evident.

plant and indicate the means adopted for reducing the various costs.

Referring to Fig. 3, showing the California shale deposit, the shale is delivered over a short run of narrow-gage railway to the elevator and crusher shown in Fig. 4. The crusher discharges directly into a 40-ton steel car. The car of crushed shale is then lowered by gravity down a 5 per cent grade over approximately one-third of a mile of standard-gage railway directly over the generator for charging. The generator takes a charge of 40 tons of shale and receives the same in a single carload.

The shale is lighted in the same manner as in the experimental generator. The 40-ton generator requires approximately 18 hours for distillation—in other words, the rate of travel of the zone of distillation downwardly through the column of shale is not affected by the increase in diameter of the apparatus.

With the method of transportation adopted as described above, the haulage item is virtually eliminated, as it was found that a 40-ton car could be handled at practically the same cost as a 1-ton car.

Fig. 3—Where the Shale Is Mined

The shale, being easily accessible, is merely shot down from the bank and loaded by hand into the mine cars.

In order to reduce the cost of discharging the generator an electrically operated movable bottom door, consisting of a grate and receptacle for the collection of oils, vapors and gases, was constructed in such a manner that the bottom of the chamber could be completely opened in a few moments, permitting the entire charge of spent shale to drop by gravity onto a concrete platform, from which it is loaded into a steel car and conveyed to dump.

The brick lining of the 40-ton generator is slightly tapered from top to bottom in order to permit the

Table I—Monthly Statement of Labor Costs for 20-Ton Experimental Shale Plant

Item	Cost	Cost per Ton	Cost Per Gal. Oil
Mining shale	$160.92	$0.438	$0.0153
Transporting shale	116.61	.317	.0110
Crushing	211.68	.576	.0201
Operating	248.74	.677	.0236
Discharging	440.84	1.200	.0419
Oil storage	21.60	.058	.0020
Water supply	28.30	.077	.0026
Repairs	40.44	.110	.0038
Fuel	25.15	.068	.0023
Miscellaneous	17.00	.046	.0016
Total	$1,311.28	$3.567	$0.1242

Summary

Shale charged, tons	367.1
Oil produced, gal	10,506
Cost per ton	$3.57
Cost per gallon	$0.124

Table II—Labor Costs Directly Chargeable to Operation of 40-Ton Generator

(Average Charge 38.5 Tons)

	No. Men	Time	Man-Hrs.	Rate	Total	Cost per Ton
Mining and crushing	5	4.5 hrs.	22.5	$0.55	$12.375	$0.3214
Transportation	6	6 min.	0.6	.55	0.330	.0085
Charging	3	33 min.	1.65	.55	0.908	.0236
Generator operation	3	8 hrs.	24.0	5.00 day	15.000	.3896
Discharging	1	40 min.	⅔	.55	0.366	.0095
Spent shale disposal	2	6½ hrs.	12½	.55	6.966	.1809
Total labor charge					$35,945	$0.9335
Power (light, pump, blower, crusher, winch) 295.6 kw.-hr @ 2c					5.912	.1536
Total direct charges					$41.857	$1.0971
Yield of oil, gal. per ton					38.89	
Cost per gallon					.028	
Cost per barrel					1.176	

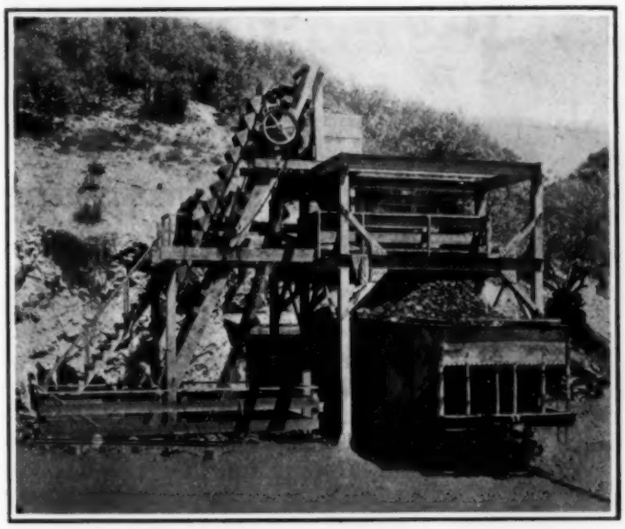


Fig. 4—Elevating and Crushing Equipment

The mine car discharges into a hopper, from which the shale is elevated to the crusher, dropping from there into a 40-ton steel car.

spent shale to have free movement in dropping from the chamber.

In Table II is given a cost summary of the results actually secured operating this forty-ton unit. These results have been checked and verified by Smith, Emery & Co., consulting engineers, of San Francisco, and by engineers employed by substantial financial interests in New York to report on the process.

By actual test five men mined 40 tons by hand in 3 hours—equivalent to 15 man-hours, or 0.375 man-hour per ton, which is a rate of 0.1875 for hand-mining operation.

Continued operation shows that the charge for electric power given is high, as the total cost over months of operation covering lights, pump, crusher, car, etc., amounts to exactly 2 cents per ton of shale carbonized.

Comparing these costs with the costs secured during the operation of the 20-ton experimental unit is an excellent illustration of how economies may be and were obtained through handling materials in large quantities, and it is needless to say that these results were very gratifying.

In California the yield of oil per ton of shale ranges from 32 to 48 gal. In Utah the yield of oil ranges up to 56 gal. per ton of shale, and it may safely be assumed that workable shale from both of these deposits will yield approximately one barrel per ton.

In Table III is a summary obtained as a result of careful examination of Utah shale oil.

Table III—Refining Report on 100 Gal. of Crude Oil From Utah Shale

Product	Gal. Refined	Sp. Gr.	Color
Gasoline	6.68	0.760	Water white
Heavy naphtha	6.70	.780	Water white
Intermediate burning oil	5.74	.804	Water white
Heavy burning oil	1.80	.822	Water white with yellow tinge
Gas oil	6.57	.857	Amber-blue
Paraffine and lubricating stock to be pressed and separated by distilling into lubricating oils	40.35		Yellow-green
Total refined products	67.84		

Petroleum coke per 100 gal. of crude oil	63 lb.
Distillation loss, including coke and gas	10.6 per cent
Sulphuric acid used per 100 gal. of crude	3.028 gal.
Acid-treating loss	22.10 per cent

Distillation Test of Oil Recovered 10 Per Cent Fractions

Fraction Per Cent	Temp., Deg. F.	Sp.Gr.	Flash Pt.	Burn	Sp.Gr. Cold
10	388	0.782	...	...	..
20	459	.829	99	120	..
30	523	.864	159	170	..
40	590	.892	208	237	..
50	629	.906	232	264	44
60	640	.911	96	212	53
70	590	.875	58	98	52
80	617	.886	64	80	53
90	685	.903	63	86	55
92.2	...	.950	52	64	87

End point, 716
Residue coke
Unsaturated hydrocarbons, 48.0 per cent. Nitrogenous tars, 1.9 per cent.
Sulphur, 0.48 per cent.

Table IV—Refining Report on Shale Oil From N.T.U. Company's Santa Maria, Calif, Plant

Gravity, deg. Bé	11.7
Flash (Cleveland open cup)	235
Burn (Cleveland open cup)	285
Chill	Sluggish at 0 deg. F.
Moisture	Trace
Per cent sulphur	5.70
Per cent sediment and moisture—A	.2
Unsaturated hydrocarbons	90 per cent
Furol vis. @ 77 deg. F	49
Per cent off at 500 deg. F	4.5

Distillation Test of California Shale Oil, 10 Per Cent Fractions

Initial B.P. 470 deg. F.

Fraction Start Per Cent	Temperature, Deg. F.	Stream Gravity, Deg. Bé
	270	
10	532	24.7
20	579	21.1
30	612	19.6
40	640	18.4
50	651	18.4
60	662	18.1
70	698	16.8
80	741	12.8
90	662	10.7

Overhead	91.25
Coke	7.59
Loss	1.16

It is believed that the quantity of marketable products will be increased above these results when the oil is refined commercially. However, these results indicate the character of the oil.

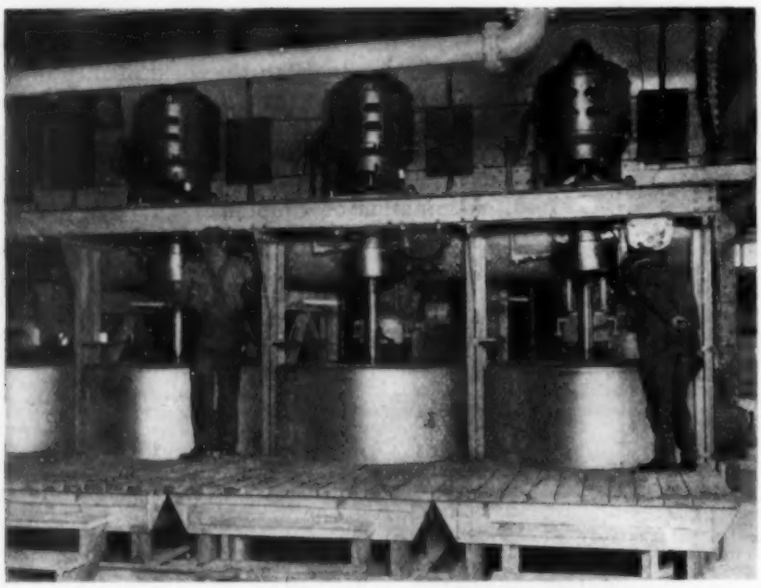
It should be noted that due to inadequate condensing equipment some of the lighter hydrocarbons were lost. Tests of the gases indicated approximately 3 gal. of gasoline per ton of shale, or approximately 6 gal. per hundred gallons of oil. Therefore the expected gasoline yield from 100 gal. of crude Utah shale oil will be approximately 12 per cent of the crude oil instead of 6.68 per cent, as shown in the summary.

The California oil is of different nature from the Utah shale oil. Table IV is a summary resulting from the examination of the California shale oil.

While it is a fact that all shale oils are refinable, it should be stated that some shale oils can be refined to greater advantage than others; for instance, the Utah and Colorado shale oils are similar to Scotch shale oil. They may be considered more or less paraffine base oils. On the other hand, California shale oil is an asphalt base, contains a high percentage of sulphur, and is not amenable to refining processes to the same degree as the Utah shale oil.

Scotch shale oil is comparable to the shale oils from Utah, New Brunswick and France, which on refining yield approximately 70 per cent of marketable products such as gasoline, kerosene, fuel oil, lubricating oils and wax.

Regarding the oil produced by this process from Utah shale a quantity of Utah shale was retorted in an externally heated retort and the oil subjected to complete refining. The results secured differed very little from the results secured from the same shale when distilled by the internal combustion process. If anything, the oil produced by the latter process was slightly superior.



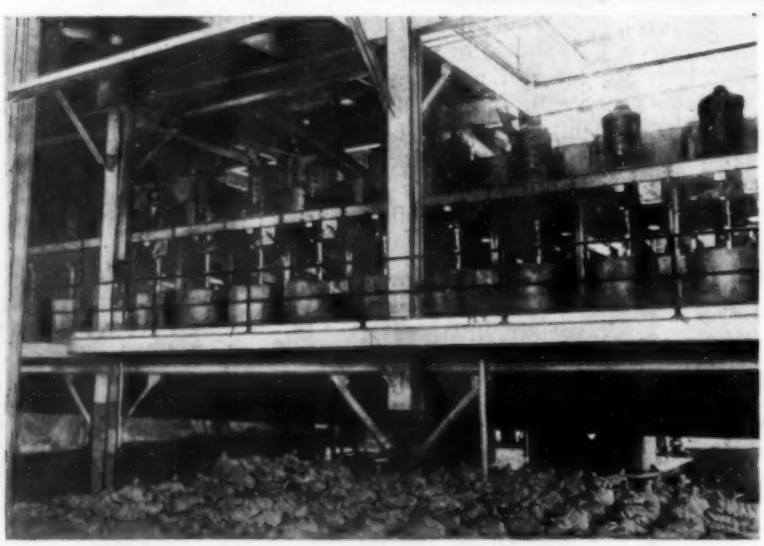
Machines That Shine In Large-Scale Production

Centrifugals in the sugar industry are thoroughly at home. No material extensively handled in process plants is better adapted to treatment in this equipment; for that reason perhaps more than for any other the technique of operation and design of machines for use in this industry has progressed to a high point.

(ABOVE) Washing station —Texas Sugar Co., Texas City, Tex. Four machines as here shown wash up to 1,000,000 lb. of sugar a day. Note the foolproof control lever, braking on one side, speeding up on other.

(AT RIGHT) Centrifugals with Lewis self-dumping baskets at Crockett, Calif., plant of the California & Hawaiian Sugar Co. Nine machines are shown here, with mixer in background. Behind the mixer nine more machines complete the raw washing battery.

(BELOW) Central Elia, Cuba, showing a battery separating crude first and second sugars from sirup. Packing and storage are shown on lower level. Native workers operate these machines without difficulty.



The three pictures shown here indicate how these machines are lined up. The mixing box above and bin system below are typical. These centrifugals have no noisy external resistance boxes and are controlled by a single lever, as shown clearly in upper photograph. That they are gluttons for production becomes clear when it is stated that with 48x24-in. direct-connected self-dumping baskets, their output will average at least 200,000 lb. of sugar per day. The motors are so slung that they may be simply disconnected from the shaft for repairs. Bronze is the material invariably used for the construction of the baskets in these machines.

How to Prevent the Caking of Crystals

Crystals Such as Ammonium Nitrate Cake in Storage, and It Is Annoying and Expensive—Here's One Way Out

By H. J. Krase, J. Y. Yee and J. M. Braham
Fixed Nitrogen Research Laboratory, Washington, D. C.

THE hygroscopicity of ammonium nitrate is one of the main obstacles to the more extensive use of this material, and particularly to its use as a fertilizer. One of the several methods investigated by this laboratory for overcoming or reducing the moisture-absorbing property of this substance is the production of the nitrate in the form of essentially round grains, which may then be given an oil coating to reduce moisture absorption. The main advantages of ammonium nitrate in the grained form over the crystalline form are that grains can be produced with a much lower moisture content than the crystals, an important point in connection with "caking" or "setting-up" of the material in storage; that grains can be made stronger than crystals, hence shattering less; and a more effective coating can be given the well-rounded, polished grains than the crystals.

Ammonium nitrate is obtained in granular form by evaporating a solution of the salt until practically all of the water has been expelled, running the viscous, molten salt into a graining pan and constantly stirring the mass while it is being slowly cooled through the freezing point. Although this process has been used for many years in plants producing ammonium nitrate for industrial explosives, there appears to be no published information on the relation between conditions of graining and the physical properties of the grain, except for a number of patents.[1]

The purpose of the experiments here reported was to determine the conditions of producing satisfactory grains of ammonium nitrate and also the feasibility of rendering the grained material sufficiently non-hygroscopic for use as fertilizer by means of coating agents.

The problem is complicated by the fact that ammonium nitrate has several crystalline modifications, the transformation from one form to another being accompanied by a very appreciable volume and thermal change, as seen in Table I.

Important practical use in the graining operation can, however, be made of the comparatively large values of the heat of transformation, particularly at the 125 deg. transition point. This will be referred to later.

Although a wide range in size of the ammonium nitrate grains for fertilizer purposes is permissible, it was desired to determine conditions for producing relatively large grains, such as 10 to 30 mesh. An effort was made also to produce as strong, well-rounded and smooth grains as possible, so that crushing and consequent exposure of new surfaces to atmospheric moisture during handling would be minimized, and so that oil coating would be most effective.

> Take advantage of the latent heat of transformation from one crystalline form to another to reduce the final moisture content of grained ammonium nitrate. That is a real idea and one of the practical suggestions developed in this study of the factors affecting graining and coating ammonium nitrate. Although this method has been practiced by explosive manufacturers, practically nothing has been published on the control necessary to obtain a product with minimum moisture-absorbing tendency.

Our preliminary experimental study of the graining process indicated that the main factors which are important in determining the properties of the grain are: (1) the freezing point (or moisture content) of the nitrate when running into the grainer; (2) the length of time the ammonium nitrate is held at the solidification or freezing point; (3) the length of time it is held at the 125 deg. transition point; and (4) the duration of stirring the grains after that transition point. A series of experiments was, therefore, made in which these factors were varied one at a time.

The graining pan used in this study was a small one, but quite similar in construction and operation to the commercial sized pans. It was about 10 in. in diameter, 5 in. deep, and was provided with a jacket for easily regulating the temperature of the charge. The plow was set at an angle of about 45 deg. to the bottom, so as to raise the graining material and drop it again behind the plow, as in the large grainers. It was operated at 30 r.p.m. The interior of the pan and the stirrer or plow were enameled. It was realized at the outset that it would be difficult to duplicate closely in such a small grainer the conditions existing in those of commercial size, and that, therefore, the results might not be directly comparable in all respects. However, in view of the fact that the graining conditions can be very carefully regulated in a small grainer, it seemed worth while to make the investigation on the scale here reported, leaving to a later time, when the facilities for experimentation on a large scale become available, the extension of the study under commercial conditions.

The ammonium nitrate used in the experiments was a synthetic, practically pure product obtained from U. S. Nitrate Plant No. 2 at Muscle Shoals, Alabama.

Table I—Crystalline Modifications of Ammonium Nitrate

Transformation	Temp., Deg. C*	Gram Cal.† per Gram‡	Vol. Change† c.c. per Gram¶
Regular ⇆ Rhombohedral	125.2	11.86	0
Rhombohedral ⇆ α Rhombohedral	84.2	5.33	−0.00854
α Rhombohedral ⇆ β Rhombohedral	32.1	5.02	+0.10964

* Saunders, *Jour. Chem. Soc.*, vol. 121, p. 698 (1922).
† Abegg's Handbuch, vol. III., p. 310.
‡ Heat evolved in transformation to a lower temperature.
¶ For change, left to right.

[1] U. S. Patents 312,010 (1885); 448,361 (1891); 448,362 (1891), and 1,131,361 (1915).

Batches having freezing points of 163, 153 and 138 deg. C. were used in these experiments, the freezing point of pure dry ammonium nitrate being 169.6 deg. C.[2] This range in freezing points was selected as representing the probable limits for satisfactory graining for the present purposes. By interpolation of the data on the relation of freezing point to the moisture content of ammonium nitrate given by Millican, Joseph and Lowry,[3] it was estimated that these batches contained approximately 0.5, 1.4 and 2.7 per cent of moisture respectively. The moisture in the final grained product was determined by heating a 10-gram sample for 4 hours in a carefully controlled oven at 95 deg. C., then weighing, and repeating the heating until constant weight was obtained. Samples were cooled in a desiccator containing phosphorus pentoxide before weighing.

Control of Graining

The graining operation consists, as previously mentioned, in uniformly stirring the viscous melt while the temperature is allowed to fall gradually through the freezing point. During the freezing process the grain is formed, the nuclei slowly appearing in the molten mass, which at this point is quite viscous. The viscosity gradually increases as the temperature falls, and the nuclei take on a more definite appearance of grains. A considerable amount of viscous melt is present as long as the temperature remains at the freezing point. As the temperature drops further, the now distinct grains grow at the expense of the melt and become well rounded. Subsequent cooling, always with a uniform stirring, especially below the 125 deg. transition point, results in a highly polished grain.

The passage through the 125 deg. transition point is easily visible if the cooling is slow and uniform, and is evidenced by the liberation of rather larger quantities of steam from the grains due to the latent heat of transformation. A marked increase in viscosity is also noticeable at this point. The rate of cooling at this point influences markedly the moisture content of the final product. A slow rate, such as results by holding the jacket temperature of the grainer high enough to keep the contents near 125 deg. for a considerable time, favors the evaporation of moisture by the heat of transformation. On the other hand, a rapid rate of cooling quickly dissipates the heat of transformation and but little evaporation results.

In Table II are shown such results of the graining experiments as can be expressed numerically. A number of tests were made on the various samples of grained material, as described later.

The sub-titles "10-20 Mesh," etc., under the column headed "Screen Analysis" refer to the percentage of the grained material passing through a 10-mesh screen, but remaining on a 20-mesh screen, etc. There was some material coarser than 10 mesh and some finer than 40 mesh, but, as will be noted, the combined percentage of these fractions was, with few exceptions, quite small.

Discussion of Results

A careful examination of the results shows that while there are certain unexplainable irregularities, the data taken as a whole indicate quite clearly the effect of a number of factors on the physical properties of the grain.

Grain Size. It is seen that the lower the freezing point (higher moisture content of the ammonium nitrate run into the grainer) the smaller is the average size of the grains. By increasing the time the charge was held at the freezing point, the size of the grains was increased. This proved to be a very important means of controlling grain size. The duration of stirring at the 125 deg. transition point and after that point does not appear to influence materially the size of the grain within the time limits considered.

Moisture Content. The moisture content of the grains has an important bearing on the "setting-up" or caking of the grained material on storage and also on the strength of the grain, as later discussed. It is, therefore, important to ascertain the factors which influence the moisture content. As will be noted in Table II, low initial moisture content (0.5 per cent) naturally results in a low percentage in the final product, the latter being practically independent of the conditions of graining. When the moisture content was as high as 1.4 per cent or higher, however, the duration of treatment at the 125 deg. transition point, at the freezing point and after the transition point was found to be important. Attention is called in particular to the advantage which can be gained in reducing the moisture content by arresting the cooling at the 125 deg. transition point for a considerable time. It is seen that the average moisture content of the product having a freezing point of 138 deg. is somewhat lower than that having a freezing point of 153 deg. It is possible that the smaller sized grains obtained in the latter case favor the more complete expulsion of moisture.

Caking or "Setting-Up." The tendency of crystalline ammonium nitrate to cake into a hard, strong mass during storage is well known. A similar behavior of grained ammonium nitrate has been observed in some cases, and hence in the present study some experiments were made to determine the relation, if any, between conditions of graining and tendency to cake. There is no doubt that the penetration of atmospheric moisture into a mass of ammonium nitrate will result in caking by partly dissolving the ammonium nitrate and then knitting the crystals together by recrystal-

[2] Early and Lowry, *Jour. Chem. Soc.*, vol. 115, p. 1387 (1919).
[3] *Jour. Chem. Soc.*, vol. 121, p. 959 (1922).

Table II—Effect of Various Factors in the Graining of Ammonium Nitrate

Expt. No.	Freezing Point (F.P.), Deg. C.	Held at F.P., Min.	Held at 125 Deg. Transition point (T.P.), Min.	Stirred After T.P., Min.	Screen Analysis 10-20	Screen Analysis 20-30	Screen Analysis 30-40	Moisture Content, Per Cent In Initial Product	Moisture Content, Per Cent In Final Product
3	163	20	10	10	36	40	8.0	0.5	0.03
4	163	20	10	60	36	42	9.0	0.5	0.16
5	163	20	30	10	22	36	12.0	0.5	0.07
6	163	20	30	60	15	28	14.0	0.5	0.06
7	163	60	10	10	74	5	0.6	0.5	0.16
8	163	60	10	60	77	4	0.6	0.5	0.10
9	163	60	30	10	81	3	0.3	0.5	0.07
10	163	60	30	60	84	7	0.6	0.5	0.11
11	153	20	10	10	39	52	5.0	1.4	(?) 2.53
12	153	20	10	60	38	46	7.2	1.4	1.57
13	153	20	30	10	33	52	9.0	1.4	0.80
14	153	20	30	60	38	45	8.0	1.4	0.34
15	153	60	10	10	62	25	2.0	1.4	1.43
16	153	60	10	60	60	37	2.0	1.4	0.62
17	153	60	30	10	38	40	4.0	1.4	0.60
18	153	60	30	60	61	34	2.0	1.4	0.42
19	138	20	10	10	5	71	16.0	2.7	1.77
20	138	20	10	60	34	55	7.0	2.7	0.58
21	138	20	30	10	27	58	6.0	2.7	0.36
22	138	20	30	60	15	72	11.0	2.7	0.33
23	138	60	10	10	30	62	5.0	2.7	0.52
24	138	60	10	60	18	65	11.0	2.7	0.68
25	138	60	30	10	34	55	6.0	2.7	0.56
26	138	60	30	60	25	62	7.0	2.7	0.33

lization. It seemed, however, that moisture within the grains might also result in caking by being slowly liberated and then producing the same effects as atmospheric moisture.

Tests were, therefore, made with ammonium nitrate grained under the various conditions given in Table II. Samples were placed in moisture-tight containers and permitted to stand for a few weeks at room temperature. Some of the samples, also in closed containers, were maintained at 30 to 39 deg. C. for 48 hours and then cooled to room temperature and examined. These latter experiments were in the nature of accelerated storage tests and, as will be observed, the temperature range included the 32 deg. transition point, where there is an appreciable thermal and a large volume change.

Caking was observed in many samples, it being accelerated in the heated samples just mentioned. Although there were a number of exceptions, the results as a whole showed that the lower the moisture content of the grained material the less was the tendency to cake. These results show, therefore, that caking can occur even when atmospheric moisture is entirely excluded. Evidently the moisture within the grain is slowly liberated and knitting together of the grains takes place, due to a partial solution and subsequent recrystallization.

Strength of Grain. The relation between conditions of graining and strength of grain was not found to be clear cut, but the results in general showed that the lower the moisture content in the final product the stronger the grain.

Coating Ammonium Nitrate

Although the rate of moisture absorption from the atmosphere by ammonium nitrate in the form of grains is very much slower than in the form of crystals, it is nevertheless so rapid that the handling of the material is rendered somewhat difficult. The advantages of coating the grains to retard moisture absorption has long been recognized by the manufacturers of ammonium nitrate for industrial explosives, and various mixtures are now used, usually containing paraffine oil, rosin, etc. Coating agents of this nature appear to be most satisfactory and commercially feasible and hence experiments were made on coating the grained ammonium nitrate with paraffine-rosin mixtures (75-25 per cent and also 50-50 per cent, respectively) and with petrolatum. To determine approximately the most suitable temperature for adding the coating agent to the grained material before the latter is discharged from the grainer, the various coating agents were added at 120 and 70 deg. C.

The results of a rather complete set of experiments on the hygroscopicity of the grained and coated ammonium nitrate, extending for a period of 40 to 60 days, showed that petrolatum was a more effective coating agent than the various mixtures of paraffine and rosin. It appears that the addition of petrolatum equivalent to 2 per cent of the weight of nitrate treated is sufficient and satisfactory, and it is possible that this percentage may even be reduced. The hygroscopicity tests indicated also that a temperature of approximately 70 deg. C. for the addition of the coating material is more satisfactory than 120 deg.

That coating ammonium nitrate greatly reduces the rate of moisture absorption was clearly shown by a number of experiments, two of which are here mentioned. Grained ammonium nitrate coated with 1.22 per cent petrolatum absorbed 0.8 per cent of its original dry weight in 2 days when exposed at 30 deg. C. to a constant relative humidity of 65 per cent. Similar grained nitrate but uncoated absorbed 16 per cent moisture in the same period when exposed at 30 deg. C. to a relative humidity of 60 per cent. Tests on similar material for 4 days at 30 deg. C. and 70 per cent relative humidity showed 1.9 and 35 per cent increase in weight for coated and uncoated grained material, respectively.

Even the best sample of grained and coated ammonium nitrate was, however, much more hygroscopic than sodium nitrate. It was found also that coated ammonium nitrate caked much less readily than the uncoated material.

Forest Products Research Has Eliminated This Waste

Not many years ago this scene could have had but one meaning—that these Eastern hemlock logs had been stripped of their tanbark and left to rot. The bark strippers of 20 years ago would no doubt have ridiculed the thought that tree carcasses of the sort which they were leaving to decay would shortly be used to the last hand's breadth. Today, however, the tanbark, seen piled at the left, is regarded merely as a byproduct and not as the only source of revenue. The logs are to be cut direct into small dimension stock for the manufacture of cases for electrical equipment. Waste will be reduced to a minimum with this method, a splendid example of the practical results obtained by the Forest Products Laboratory, Madison, Wis.

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Why Not Make Our Metallic Sodium From Common Salt?

European Investigators Have Conquered Many of the Difficulties in Electrolytic Production From Fused Sodium Chloride Which Have So Far Prevented Industrial Application of the Method in This Country

By Dr. H. Danneel
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THE OPINION has long been held, and is still more or less prevalent, that the commercial production of metallic sodium by electrolysis of fused sodium chloride is not feasible on account of the greater difficulty as compared with the relatively easy electrolysis of fused sodium hydroxide. Commercially, the decision between the two processes requires due consideration of all local conditions.

It will be shown in the following paper that the fused chloride process is both technically and commercially feasible and that the prejudice against it, although readily understood, is not justified.

The high melting point of NaCl (800 deg. C.) is responsible for most of the difficulties. Although it can be lowered to 500 deg. by mixing with other salts, it is necessary to work at 600 deg. to avoid local solidification. Yet at this temperature the liberated Na and Cl are extremely active and corrosive, making the choice of equipment material difficult. Moreover, the Na has a high vapor pressure, must be protected from air, and is soluble in the fused salt. The heat must be supplied electrically within the system.

Experiments were carried on by the writer and his co-workers from 1902 to 1914 with a view to overcoming these difficulties. By 1913 sufficient progress had been made to justify an attempt at commercial production, which was undertaken in Geneva. A factory was then built in Bozel (Savoy), which began to operate early in 1914. The war halted the enterprise, but not before some lessons had been learned.

Four attempts to utilize an iron furnace cooled from the outside and lined with a layer of solid NaCl failed because the lining cracked and permitted deposition of Na on the iron wall. A successful design in stoneware was finally worked out. The only satisfactory chlorine-resisting anode material was found to be carbon, which must be carefully prepared to prevent disintegration. The best form for the anode was found to be a series of alternately short and long carbon plates, cemented together with graphite and water glass.

For the cover and chlorine receiver surrounding the anode, the only suitable material stable to chlorine and fused salt and non-conducting proved to be chemical stoneware. The difficulty of obtaining a seal between this material and carbon was overcome by use of a paste of graphite, pitch and water glass.

The anode must be readily removable, and surrounded on all sides by liquid electrolyte; to allow it to freeze fast at any point means breakage. It cannot be repaired on the spot, and so must be easily interchangeable. To permit ready escape of the chlorine and prevent condensation of spray and salt vapor, sufficiently high temperature around the anode must be maintained. This necessitates a high current density, which must be carefully controlled.

The cathode, which is maintained at red heat, must be a metal that does not alloy with Na. Cast iron is unsuitable, because the hot Na dissolves out the C and Si. Cast steel, however, gives good service. The best current density at the cathode is 1.2 to 1.5 amp. per sq.cm. It should not be too high, or some K will be liberated and there will also be a loss of yield due to the temperature increasing the solubility of Na in the fused salt. Too low current density is even worse; the temperature of the electrolyte must be kept high enough to prevent local freezing as well as the deposition of Na into veins in the electrolyte. The form of the cathode is specified by several requirements. The under side, where the Na is separated, must be as flat as possible. While the current is flowing, the under surface, formed like a crater, must be covered by the floating Na. The latter flows over the rim of the crater below the cap, that covers the crater, into a slanting outlet pipe.

This pipe for Na is placed so high that the point where it passes over the wall is protected against the current lines. Otherwise it would function there as a cathode and give rise to a rapid corrosion of the wall. This place is one of the most sensitive of the four walls. Unavoidable changes in level of the electrolyte cause the pipe to become clogged, or in the worst cases to act as a siphon and drain a few hundred liters of red hot melt into the receiver containing sodium under kerosene. The result can be imagined. To avoid this it is necessary to keep a layer of Na about 5 cm. deep around the cathode so that changes in level cause noth-

Many engineers hold the view that the production of sodium by the electrolysis of common salt is impractical because of the greater operating difficulties than in the case with fused sodium hydroxide. Perhaps this is true with the pure salt, but Dr. Danneel has successfully proved that a mixture of salt with sodium and potassium fluorides is better than pure salt as far as commercial practice is concerned. He has devised a simple cell with which he expects to produce sodium at about 10 cents per pound. The development of his method and the practical means he suggests for solving the usual difficulties of the process are of broad interest.

ing but Na to be carried over. The outlet pipe must be wide enough to permit cleaning, since it is impossible to prevent small accumulations of Na_2O and Na_2O_2.

Na should never be allowed to form outside of the cathode where it floats on the electrolyte and oxidizes to Na_2O. Such an occurrence has many harmful results which automatically increase. It dissolves in the fused chloride and become electrolyzed; O goes to the anode, where it forms CO and $COCl_2$. Again, some of the Na_2O combines with silica in the furnace walls; the silicate is electrolyzed, and CO and $SiCl_4$ are formed. Thus the chlorine yield is greatly reduced and the anode is rapidly destroyed.

Insulation Difficulties

The thorough insulation of the outside of the cathode thus necessitated is one of the principal difficulties. Coatings of such non-conductors as enamels on the cathode are very short-lived. The difficulty can be overcome by placing a non-conducting shield in front of the surface to be protected; but many attempts of this sort failed before any succeeded.

When deposition of Na begins away from the cathode, due to a defect in insulation, it spreads through the electrolyte, and it is useless to try to stop it. Hence the protecting shield must give thorough insulation and must be reasonably durable. Quartz, asbestos, stoneware and other siliceous substances are attacked by the Na_2O formed by oxidation. Plates of zirconia, about 7 cm. thick, are fairly durable; but Na gets in between plate and cathode and causes separation, sometimes even breaking the plate.

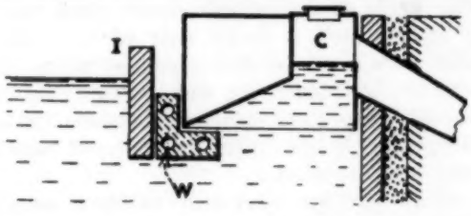


Fig. 1—Water-Cooled Cement Insulation for the Cathode

The cement angle plate is cooled by water circulated through the three pipes shown at *W*. In practice the plate would adhere to the cathode *C* by solidifying the intervening layer of fused salt.

The best results were obtained by use of a cement angle plate (See Fig. 1) in which three pipes (for cooling water) were imbedded. Even this arrangement, however, is short-lived. The final conclusion is that it is useless to attempt permanent insulation of the cathode. The arrangement must be such that replacement causes a minimum of expense and delay. The water-cooled cement insulation is best. The crust around it must be melted, and the electrolyte kept liquid by an alternating current when replacement is necessary. It was in following out this line of thought that a furnace was designed which could be safely put into commercial operation.

The Cooled Insulator

The best insulating material proved to be a good grade of Grenoble cement surrounding water-cooled iron pipes. It is true that cracks appear when the insulator is dipped in the fused salt; but they do not penetrate to the iron on account of the iron oxide-cement compound, which is responsible for the adhesion of cement to iron. The cracks fill with melt, which keeps them tight on account of the active cooling. Many other protective coverings were tried, but none of them equaled cement in satisfactory service. Care is essential in preparing the cement covering; air bubbles must be avoided and the coating must not be too thick.

The separator cement bar *I* (see Fig. 1) with the projections carrying the inlet and outlet pipes, stands against the side walls of the furnace and is pressed close against the free side of the cathode and the corner blocks next to it. Its lower edge is placed a few centimeters below the lower edge of the cathode. In time, however, even the cement insulator is attacked, especially adjacent to the lower edge of the cathode. This is harmless until Na escapes under it into the electrolyte space; then replacement is necessary. A properly made insulator can be used for several weeks. They must be allowed to set for a long time (about 14 days) in the mold, and then thoroughly air dried. It is advisable to heat them to about 300 deg., just before use, in order to expel air from the pores.

Since the corner blocks are among the most susceptible parts of the furnace, it is well to separate them also from the cathode by similar insulators, which in this place will last at least as long as the furnace itself. No such protection is necessary on the rear wall; the stoneware plate there lasts for months.

Composition of Electrolyte

The electrolyte is composed of the 4 ions Na, K, Cl and F. It also contains small amounts of Ca, Al, Si and Mg introduced by the old electrolyte, of which about 80 per cent of the amount in dismantled furnaces is recovered. These metals are deposited early in the electrolysis, and make the product brittle for the first 2 days. The NaCl, which is constantly being added, always contains water, part of which dissolves in the electrolyte in spite of the red heat. This is proved by the fact that the cathode cover is always full of hydrogen. Salt to be added during operation should be thoroughly dried; this it is best to melt and pour in.

Some K is always liberated at the cathode, and a very little F at the anode. The amounts depend on the composition of the electrolyte immediately adjacent to the electrodes. In charging during operation care must be taken that the added NaCl passes under the two covers as quickly as possible so that the concentration of K and F around the electrodes does not increase. With high current densities and insufficient additions of NaCl, so much K may get into the product that it becomes brittle.

A salt mixture of 1 mol (70 per cent) NaCl and ½ mol (30 per cent) KF melts at 550 deg., but gives 2 per cent K in the product. But 6.5 per cent K and 11.7 per cent F will give a metal resembling pure Na in physical properties, containing 0.5 to 0.6 per cent K. Threads of this metal can be twisted without breaking. But whereas the Cl from the first mixture has no perceptible trace of F, that from the second mixture gives a qualitative test for F. The bad effect of F is that it attacks the electrode, forming CF_4 from carbon and SiF_4 from the stoneware portion. Besides, F costs more than K, and so it is desirable to choose an electrolyte which will just touch the permissible limit of K

in the Na. This is true of an electrolyte containing:

72 per cent NaCl + 10 per cent KF + 18 per cent NaF

or

62.5 per cent NaCl + 25 per cent NaF + 12.5 per cent KCl,

having approximately

38 per cent Na, 44 per cent Cl, 6.5 per cent K and 11.5 per cent F.

Commercial Operation

The work described above was all carried out in an experimental (1,200-amp.) furnace shown in Figs. 2 and 3. The plant in Geneva and the factory in Bozel (Savoy) each had a 4,000-amp. furnace, which for 80 per cent yield should produce about 65 kg. per day.

To start the electrolysis, the bottom is covered with 10 cm. of pure NaCl and the anode is hung in the furnace. The finely powdered electrolyte is then packed in by hand, particular attention being given to the spaces between the segments of the anode. The insulator is not yet put in. The charge is melted by an alternating current. An arc is then caused to pass from an iron rake connected to the cathode current and an iron rod connected to the anode. This forms a sump, which is gradually spread toward the anode. As soon as it reaches the anode it begins of itself to carry current, and the rod is taken away. This point is reached in about 15 minutes, during which time the current density increases from 50 to about 500 amp. The sump should not be allowed to run into the loose salt, because remelting a solidified melt is very tedious. After about 15 minutes the sump reaches the anode and after an hour the cathode also. After another hour or two the furnace is full and the charge is well melted. Direct current cannot be used to melt the charge, since it would liberate Na and Cl and contaminate the electrolyte.

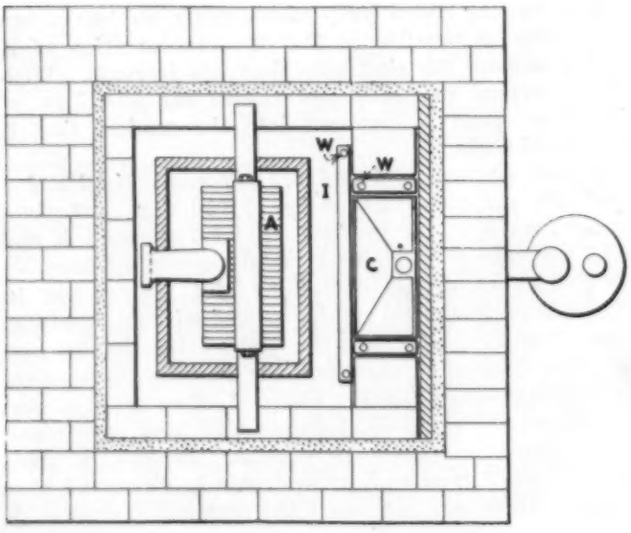
The outer surface of the cathode is then freed from adhering salt and the insulator quickly dipped in, its ends being pressed close to the corner blocks. It soon becomes covered with a layer of solid salt and sticks fast to the cathode. The alternating current is then turned off and after 10 minutes (to allow the salt layer to thicken) the direct current is turned on.

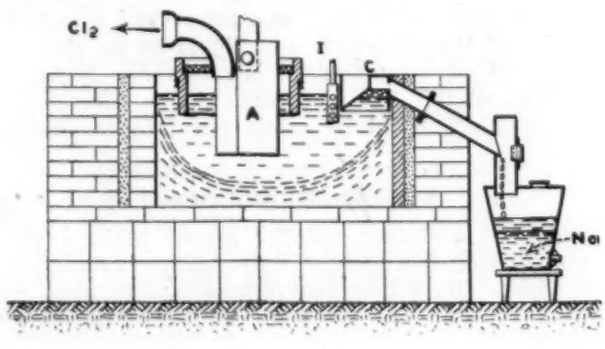
The small furnace should yield 25 kg. of Na per day, but actually gives only 20 to 22, or approximately 1 kg. per kilowatt-day. It would be difficult to lessen the power consumption, since it is determined by the size of the furnace and the heat required to keep the electrolyte melted. The decomposition of NaCl requires, as is well known, 4.2 volts. A value of 3.4 volts was found by extrapolation of voltage curves. The transition potential at the anode accounts for 2 to 5 volts, the remaining 11 volts being required to heat the electrolyte. There is not much to be gained by putting the anode closer to the cathode; a difference of 1 cm. would save only 0.18 volt. A suitable distance between the insulator and the anode frame is 15 cm. A smaller interval favors formation of a crust across the gap, which must be avoided because additions of NaCl are to be made there, and because the crust hinders detection of the escape of Na above the insulator. The necessary steps to remedy this condition would then not be taken soon enough.

Operating Technique

Tending the furnace during operation is a simple matter. The cathode and outlet pipe must occasionally be scraped clean. The level of the electrolyte must be maintained by adding NaCl; it can easily be kept constant within 0.5 cm. The level should be measured as often as possible. When the melt is 4 cm. below the edge of the overflow pipe in the cathode, it is 6 cm. below the inside of the cathode cover, since the specific gravity of the melt is twice that of the molten Na. Particular care must be exercised not to let the melt rise above the overflow level, which would clog the pipe. Potential differences are measured between the cathode, the cooling pipe, a rod dipped in the melt between the electrodes, and the anode.

The results are intended only to show whether the cooling pipe has entered the circuit as a cathode (in which case the potential between pipe and anode is as great as between cathode and anode), whether important changes in the internal resistance have occurred (for example, when the anode becomes surrounded by a layer of glowing gas due to too high current density, the potential between rod and anode rises from about 8 to about 20 volts), etc. As long as the sum of the potentials (cooling pipe to anode) + (cooling pipe to cathode) is a great deal less than the total voltage, it is certain that no Na is as yet being liberated at the pipe. When such is not the case, a bright red glowing spot of Na generally appears floating on the surface of the electrolyte. An effort to remedy this condition





Figs. 2 and 3—Plan and Cross-Section of a 1,200-Amp. Experimental Furnace for Producing Sodium From Sodium Chloride

Experiments with this furnace preceded the construction at Geneva and Bozel (Savoy) of 4,000 amp. furnaces, each capable of producing 65 kg. of sodium per day. The small furnace requires 20 to 21 volts at the beginning of its operation, but only 21 to 22 kw. after a few hours; that is, it consumes 21 to 22 kw. It yields 20 to 22 kg. of Na per day, or approximately 1 kg. per kw. In these figures C = cathode, A = anode, I = cement insulating bar and W = water cooling pipes.

should then be made by passing in an alternating current for 10 minutes. The alternating current (about 3,000 amp. at 30 volts) quickly removes Na from the entire bath. This treatment often suffices to repair the defect in the insulator. If it does not, the fact can be easily detected in a few minutes after the direct current is again turned on. It is then time to replace the insulator. For that purpose, heating with the alternating current is continued somewhat longer, the old insulator is removed, and a new one is put in just as when the furnace is being started up. This replacement takes 20 or 30 minutes.

If Na still continues to appear outside the cathode, the trouble is more deep-seated and more strenuous treatment must be given; the furnace must be stopped. The same is true when a great decrease in voltage or yield indicates that the bottom is too dirty. In that case, heat is applied with an alternating current, the plate and anode are removed and the hot electrolyte is poured out until it is about 20 cm. deep. The remainder can be easily removed after it cools, because the layer of common salt at the bottom prevents it from sticking. Usually the trouble is in the corner blocks. Replacing these takes only about a half day. In many cases the inside masonry and the masonry at the cathode need replacing. This can be done by two masons in 1 to 1½ days.

Usually a furnace lasts 6 to 8 months, and sometimes much longer, before such extensive repairs are necessary. The furnace should never simply be allowed to cool; it must be emptied before being stopped for any considerable time. The electrolyte contracts as it solidifies, and would destroy the anode and the entire inner wall of the furnace. Moreover, if allowed to solidify in the furnace, the salt cannot be remelted and emptied out; it must then be broken up with a chisel.

Of course the anode may also disintegrate prematurely, especially if it is not dense. Such an occurrence can be detected by the anode voltage. It is then generally found that the carbon has been attacked and has fallen to the bottom in bits. A properly made anode lasts 1 to 3 months. Replacement is easy, since the electrolyte is kept liquid around the anode.

The sodium discharge pipe, which is set into the furnace wall with a downward slant, empties into a perpendicular shaft, which opens into a large pot containing high-boiling petroleum fractions. In large furnaces the Na carries over enough heat with it to keep it liquid in the pot, so that it can be drawn off through a tap hole direct into the molds. The molds hold 1 kg., since Na is sold in bars about 7x7x20 cm., which weigh exactly 1 kg. Tin boxes are packed with 100 of these bars, soldered shut and put in wooden boxes for shipment.

A Pre-War Cost Sheet

A cost sheet for present-day operation would not give a correct picture, hence recourse must be made to pre-war costs. Even these must be taken with mental reservations, because there are no figures for large-scale production over a long period of time. The calculation can be made only on the basis of the relatively unfavorable results of the experimental installation in Geneva. Hence the figures given are probably too high.

A small factory, having enough furnaces so that twenty are in operation at all times, is taken as the basis. The furnaces are supposed to be run on an average 23.5 hours per day at 4,000 amp. and 18 volts, direct current, and 0.5 hour per day at 6,000 amp. and 30 volts, alternating current (to allow for changing insulators, etc.). This size of furnace requires two anodes. It is further assumed that each furnace is emptied for repairs every 4 months, that the insulators last only half a month and that the anodes must be replaced every 2 months. These estimates, however, are rather too unfavorable than the opposite. The yield of Na, ready for market, is assumed to be 80 per cent and that of Cl 90 per cent. The furnace capacity is about 3,000 kg. of salt.

Labor is reckoned at: 1 manager 2,400 marks, 1 smith, 1 mechanic and 2 masons 8,000, 2 foremen 3,500, 20 laborers 30,000, 3 assistants 3,600; total approximately 50,000 marks. At Geneva a finished anode costs 150 marks; repairing an insulator 2 marks; repairing a furnace (for materials only) 50 marks. The price of NaCl may be taken as 50 marks per ton; KCl, 100 marks; NaF, 500 marks. Electrical energy may be reckoned at 0.01 mark per kilowatt-hour. Costs may then be summarized as follows:

	Marks	Marks
Current, 13,000,000 kw-hr. at 0.01		130,000
Salt: 1,300 tons of NaCl at 50	65,000	
10 tons of NaF at 500	5,000	
10 tons of KCl at 100	1,000	
		70,000
Material: 480 insulators at 2	1,000	
240 anodes at 200	48,000	
60 repairs at 50	3,000	
4,600 cases at 5	23,000	
Miscellaneous	5,000	
		80,000
Labor		50,000
Overhead, etc.		50,000
Total		380,000
Sale of 800 metric tons of Cl		80,000
Total yearly cost for 460 tons of Na		300,000

Hence the production cost, without counting interest and depreciation, is 0.65 mark per kg. of Na.

It is certain that a saving could be made in the cost of salt by locating the factory near a source of supply; the life of the anodes can probably be doubled; when things go smoothly the same number of men could probably operate thirty or more furnaces; the cost of packing could be considerably lessened by having the cases returned, or by charging the customers for them; and more than 100 marks per ton could be realized from the Cl by working it up in the factory itself. On the other hand, electrical energy would probably cost more than 0.01 mark per kilowatt-hour. All factors considered, however, it is probably not too optimistic to predict that Na can be produced by this process for 0.50 mark per kilogram, or 10.6c. per lb.

Contracts Awarded for French Synthetic Ammonia Plant at Toulouse

The program of the French Government which calls for the transformation of 100 tons per day of atmospherique azote at the former powder plant at Toulouse is already well under way.

Contracts for construction have been awarded as follows: Schneider et Cie., for the first part of the plant for catalytique hydrogene, 16,281,750 francs; Compagnie de Produits Chimiques d'Alais, for the installation of the synthetic ammonia plant (Casale process), 13,500,000 francs; Compagnie de Construction de Fours, construction of a gasogene aërated by oxygene, 229,000 francs.

All these various elements are in process of construction and the entire plant will be in working order in 1926.

On the Engineer's Book Shelf

Taylor's Treatise—An Outstanding Co-operative Effort in Physical Chemistry

Reviewed by Eric R. Jette
Department of Chemistry, Columbia University

A TREATISE ON PHYSICAL CHEMISTRY. A co-operative effort by a group of physical chemists. Edited by *Hugh S. Taylor*. Two volumes, 1,359 pages. D. Van Nostrand Co., New York. Price (two volumes), $12.

To review the work of seventeen writers, especially when their work compresses the entire field of physical chemistry into two volumes, really requires one reviewer for each branch of the subject. The present writer is anything but omniscient; it required but a very brief dip into the wealth of material included between the black covers of "Taylor's Treatise," as it will probably be called, to confirm the fact. The following remarks are therefore governed largely by the restricted viewpoint of the writer, and a number of excellent things contained in the discussions given by various authors have undoubtedly been overlooked.

It is apparent from the preface that these two volumes are intended primarily for advanced students and for research workers in physical chemistry and in the industries, but it is suggested that they might also serve as a text. It would seem to the reviewer that the "Treatise" could be used by beginning or less advanced students only under the direction of an unusually competent teacher.

Space does not permit a detailed examination of all the various chapters. The first two, on the "Atomic Concept of Matter" and on the "Energetics of Chemical Change," form an excellent foundation for the work which follows. Chapters III and IV discuss gases and liquids, chiefly from the kinetic viewpoint. In clarity and originality, and in the definite kinetic picture resulting from the author's discussion, these two chapters are better than anything the present writer has seen in a work on physical chemistry. It is only regretted that the treatment of liquid crystals (p. 132) was not more extended. Solids are discussed in the short and well-written Chapter V. It was noted that the Grüneisen relation between the specific heat and the coefficient of thermal expansion was not mentioned.

It is possible to subdivide physical chemistry in a great number of ways, but the subdivisions will necessarily overlap. In a co-operative work such as the present one there will be a certain tendency toward repetition. No grave objection can be raised against this; in fact, it is sometimes of considerable advantage. But there is also a possibility that between two or more writers on related subjects some things will be omitted, each writer expecting that another has included them. The chapter on the "Solid State" contains at least two illustrations of this. Chapter V mentions the melting points of various solids; heats of fusion are given in Chapter VI. The Trouton-Crompton rule (analogous to the Trouton boiling point relation, pp. 120 and 197), which connects the two, is omitted entirely. The Lindemann melting point relation (*Phys. Zeit.*, 1910, vol. 11, p. 609) suffers the same fate, since the quantum theory of specific heats is not taken up until Chapter XVII, at which point there was no particular interest in correlating the atomic frequency of an element in the solid state with any other property of the solid. Yet the question of atomic vibration could not have been treated in Chapter V without going considerably more into detail regarding specific heats than the editor apparently desired.

In the subject of solutions even more important matters have been omitted, the various phases being divided among four authors. Chapter VII, on "Dilute Solution," is an excellent and thorough treatment written from the purely classical point of view. The more modern aspects are discussed in Chapter XII, on the "Electrochemistry of Solutions." Conductivity and ionic equilibria are contained in Chapter XI. Such important topics as the deviations from Raoult's law and the effects of internal pressure and of polarity obviously belong under none of these titles and thus received no attention at all. In Chapter IX, on "Heterogeneous Equilibrium," where as a last resort one might expect to find such matters discussed in their relation to solubility, we find merely a half page (p. 453) dealing with an ideal case and fourteen lines of fine print (p. 454, top), containing an extremely scanty notice of the works of Hildebrand and of Mortimer. Since all of these subjects are well known and it is hardly conceivable that the individual authors were not acquainted with them, such omissions must have been due to occasional lapses in the co-ordination mechanism involved in building up the book as a whole.

One other comment may be added regarding Chapter IX. It seems a bit strange that space could not have been spared for a rigorous derivation of the phase rule, when the rule itself was considered of sufficient importance to devote seventy-seven pages to descriptive material depending upon it.

Chapter VIII, on "Homogeneous Equilibrium," in very well done; the derivations of the various forms of the Mass Law with the indications of conditions under which each is applicable are particularly good.

Chapter XI, on "Conductance, Ionization and Ionic Equilibria," is a veritable mine of facts and references. It may be suggested in passing that the conductivities of the silver halides (p. 497) apparently do change on fusion (cf. Hevesy, *Zeit. phys. Chem.*, 1922, vol. 101, p. 344) and that the precipitation of NaCl from a saturated solution by passing in HCl gas (p. 579) is not a particularly happy example to illustrate the solubility product law.

Chapter XIII gives a valuable survey of electrometric methods as applied to chemistry which should be of considerable interest to practical workers.

The critical discussion of the various hypotheses on reaction velocities in homogeneous systems in Chapter XIV is illuminating. However, the author's attention

might be called to the fact that in discussing the empirical Arrhenius equation $\frac{1}{k}\frac{dk}{dT} = \frac{Q}{RT^2}$ (pp. 899-902), which is related to the van't Hoff isochore (p. 899), it is not mentioned that the temperature coefficient of a chemical reaction varies inversely as the square of the temperature only when Q is actually constant over the temperature range considered and when the reaction takes place at constant volume. In addition it is to be noted that there is not a single reference to Brönsted's comprehensive work on ion catalysis (*Zeit. phys. Chem.*, 1922, vol. 102, p. 169).

At the present time, when so much attention is being given to the structures of atoms, it might be expected that a new treatise on physical chemistry would devote a considerable section to such matters. Chapter XVI, on "The Quantum Theory in Physical Chemistry," is quite up to our expectations. It begins with an excellent discussion of radiation in general, the theories and equations pertaining to it and its application to chemical reactions. Then follows theories of atomic structure, the theories concerning both the static and dynamic atoms being reviewed in considerable detail. The portion dealing with Bohr's theory is clear, not too thickly sown with mathematics, and is written in a style that should appear to most students of chemistry.

A few comments on this chapter are unavoidable. For example, some of the shortcomings of the Lewis atom as extended by Langmuir might have been indicated; such as the inability to account for spectral lines, and the fact that one of the most important predictions made from it was wrong (i.e., element 72 should be a rare earth). Table VIII, p. 1062, and the statement on p. 1066 referring to the newly discovered element hafnium are decidedly misleading in this respect. The proper classification of Hf as similar to Zr based on considerations of the static atom was performed by Bury, whose work is only briefly mentioned on p. 1129. The statement at the top of page 1116 cannot go unchallenged: "It is readily seen that by arranging the orbits in certain relative positions to each other, Bohr has attained virtually the same result as Langmuir and Lewis in their theory of the static atom." This statement contains at least two implications which are as inaccurate as they are unjust!

Chapter XVII, on "The Third Law of Thermodynamics," is an exceptionally fine treatment of a difficult subject. It involves considerable quantity of mathematics, of course, but the author manages to give a great deal of the essential points involved in the final equations in a few sentences following their derivations. It was also pleasing to see such fundamental matters as the equipartition principle and the statistical basis of thermodynamics included in this chapter.

Those of the above comments which appear to be unfavorable criticisms after all concern only a small portion of the entire amount of material discussed. It must not be forgotten that there are 1359 pages in this Treatise, covering the entire field of physical chemistry, with extensive excursions into the related branches. Too much cannot be said for the excellence of the work as a whole, in style, in presentation and in the multitude of facts and theories included. The editor's work has been admirable in many respects, particularly in the subdivision of the field and in assigning special chapters to the Third Law and to infra-red radiation in chemical processes, subjects which usually are only incidental matters. The publishers are to be complimented on the fine make-up of these two volumes, the quality of the illustrations, and an unusual freedom from typographical errors. The complete index for both volumes given at the end of each is a great convenience.

The review would not be complete without a hearty recommendation of this "Co-operative Effort by a Group of Physical Chemists" to all students and research workers in physical chemistry who wish a comprehensive and authoritative discussion of the field. It is certainly the largest and most complete work of its kind yet produced in this country.

Technology of Synthetic Organic Compounds

SYNTHETIC ORGANIC COMPOUNDS. By *S. P. Schotz*, consulting research chemist and chemical engineer. 412 pages, illustrated. Ernest Benn, Ltd., London. Price, 45s.

Without attempting to compile a dictionary, the author has treated the technology of a large number of important synthetic organic compounds, grouping them under the following heads: chlorinated hydrocarbon solvents; other synthetic solvents; synthetic aromatic compounds, esters, vanillin, camphor, etc.; antiseptics and disinfectants; sweetening agents; intermediates for the manufacture of dyes; synthetic tannins; explosives; artificial silk; chemical warfare; plastic masses, celluloid and synthetic resins. Theory and manufacturing details have been combined to give a treatise of real value.

Cane Sugar Manufacture

CANE SUGAR AND ITS MANUFACTURE. By *H. C. Prinsen Geerligs*, director, home branch office, Experiment Station for Java Cane Sugar Industry, Amsterdam. Second edition, 342 pages, illustrated. Norman Rodger, London. Price, 20s.

As in the first edition, emphasis has been placed on the chemical aspects of cane sugar manufacture rather than on the details of mechanical equipment. Theory and practice have made such great strides since 1911 that many sections, particularly those on juice extraction, clarification, filtration, preservation of sugar and molasses, have undergone radical changes to bring them in line with modern practice.

Chemical Terms

THE "CHEMICAL AGE" CHEMICAL DICTIONARY: CHEMICAL TERMS. 158 p. D. Van Nostrand Co., New York. Price, $4.50.

Because of the peculiarly intricate terminology of the chemical sciences, helpful reference dictionaries will always be in demand. The present dictionary, as the sub-title would imply, is limited to chemical terms, organic, inorganic, physical, analytical and biochemical. It is planned to supplement this volume with others on different phases, such as "Organic Substances," "Inorganic Substances," etc. This is an idea of great promise.

Survey of New York as Chemical Center

CHEMICAL INDUSTRY IN NEW YORK AND ITS ENVIRONS: PRESENT TRENDS AND PROBABLE FUTURE DEVELOPMENTS. By *Mabel Newcomer, Ph.D.*, associate professor of economics, Vassar College, 49 p. Published by Plan of New York and Its Environs, New York. Price, $1.

This survey, which was summarized in preliminary form in *Chem. & Met.*, March 17, 1924, pp. 422-425, has now been published in full. Chemical manufacturers

already located in the New York district will find the economic conclusions of this survey most pertinent, while firms contemplating the establishment of a plant in the district should by all means study the report carefully. Chief among the graphical features are four maps showing the location of the chemical plants in the district in 1900, 1912, 1917 and 1922, industry groups and size of establishment being indicated by symbol.

Portland Cement Industry

HISTORY OF THE PORTLAND CEMENT INDUSTRY IN THE UNITED STATES. By *Robert W. Lesley*, first president, Portland Cement Association, in co-operation with *John B. Lober*, president, Vulcanite Portland Cement Co., and *George S. Bartlett*, Universal Portland Cement Co. 330 pages, illustrated. International Trade Press, Inc., Chicago.

Here is the dramatic story of one of our great industries told by men who have been leaders in the development. The completeness of the amount is evidenced by the chapter heads, as follows: Cements and their definitions; among the pioneers in natural cement; discovery of portland cement; imported portland cement in the United States; portland cement industry in the United States; other cements; leading pioneer companies; development of the industry; mechanical side of the industry; commercial development of the industry; the scientific side; the day of the promoter; the constructors; cement industry in relation to the war. Appendices include: History of the Portland Cement Association; history of the industry by years; historical notes on cement manufacturers; specifications.

Of Great Importance to Organic Chemists

SYNTHESIS OF NITROGEN RING COMPOUNDS. By *Cecil Hollins*, with an introduction by *Prof. J. B. Cohen*. 423 pages. D. Van Nostrand Co., New York. Price, $12.50.

This monumental treatise provides a survey of the methods by which cyclic compounds containing a single hetero-atom (nitrogen) have been prepared. It is intended to supply complete answers to the questions: What methods are available for the synthesis of a substance of a given type? and What compounds of that type have been synthesized?

Pulp and Paper Series Completed

MANUFACTURE OF PULP AND PAPER. Vol. V, 550 pages, illustrated. McGraw-Hill Book Co., New York. Price, $5.

This volume completes the textbook of modern pulp and paper mill practice prepared by the committee representing the industry in the United States and Canada. It covers: cylinder and special machines; hand-made papers and tub sizing; paper finishing; coated papers; testing; general mill equipment.

Revised Texts and Translations

LEHRBUCH DER CHEMISCHEN TECHNOLOGIE. By *H. Ost*, professor emeritus of technical chemistry at the Technischen Hochschule, Hannover. Fourteenth edition, 828 pages, 330 illustrations. Dr. Max Jänecke Verlagsbuchhandlung, Leipzig. Price, paper 15 goldmarks; bound 16.20 goldmarks.

With the approach of more normal industrial conditions, Professor Ost made it a point to get in close touch with a large number of firms in order to reflect correctly in this latest edition the post-war trends in chemical technology. For those who read technical German, this work has long held a prominent place among the single-volume surveys of technology in the chemical industries.

VOLUMETRIC ANALYSIS. By *Francis Sutton*. Eleventh edition, revised throughout, with numerous additions by *W. Lincolne Sutton* and *Alfred E. Johnson*. 629 pages, illustrated. P. Blakiston's Son & Co., Philadelphia. Price, $9.

A revision of this standard work is most welcome, as the last previous edition was published in 1911 and has been out of print for several years. Few technical books can point to a first edition in 1863 and a position of authority for over 60 years.

QUANTITATIVE ORGANIC MICROANALYSIS. By *Fritz Pregl*. Translated from the second revised and enlarged German edition, by *Ernest Fyleman*, chief chemist, J. F. Crowley & Partners, London. 190 pages, 42 illustrations.

Microscopic methods are particularly well adapted to the problems of organic research, where frequently the identification of minute amounts of material is necessary. The details of Professor Pregl's ingenious methods have been made more readily available to English-speaking workers in Mr. Fyleman's excellent translation.

THE RARE EARTHS: THEIR OCCURRENCE, CHEMISTRY AND TECHNOLOGY. By *S. I. Levy*. Second edition, 362 pages. Longmans, Green & Co., New York. Price, $6.

This new edition takes into account all work appearing in the literature up to the end of June, 1924. Every chapter has been entirely revised and that on radioactivity of minerals completely rewritten.

IONS, ELECTRONS AND IONIZING RADIATIONS. By *James A. Crowther*, professor of physics at University College, Reading. Fourth edition, 328 pages, illustrated. Longmans, Green & Co., New York. Price, $4.

In the field covered by this standard work, frequent revision is necessary to keep pace with the rapid accumulation of data. To chemists it is particularly interesting as reflecting the physicist's viewpoint.

PROTEINS AND THE THEORY OF COLLOIDAL BEHAVIOR. By *Jacques Loeb*. Second edition, 380 pages, illustrated. McGraw-Hill Book Co., New York. Price, $3.50.

Experimental evidence developed by Dr. Loeb subsequent to the publication of the first edition but included in the German and French editions has been incorporated in this new edition so that it represents a complete discussion of Dr. Loeb's work in this field.

THE KINETIC THEORY OF GASES. By *Eugène Bloch*, professor at the Lycée St. Louis. Translated by *P. A. Smith*. 178 pages. E. P. Dutton & Co., New York. Price, $3.

Dating from investigations of Daniel Bernonilli in 1730, the kinetic theory has developed to a point characterized by Professor Bloch as "the most perfect and most completely developed branch of the molecular theory of matter." The modern conceptions of the theory have been expounded in clear, concise fashion by author and translator.

Reid's Organic Research

D. Van Nostrand Co. has notified us that the price of E. Emmet Reid's "Introduction to Organic Research" is $4.50 instead of $5 as originally announced and as stated in the review of this book in our Jan. 12, 1925, issue, p. 60.

Important Articles in Current Foreign Literature

"Considerations in the Choice of Extraction Equipment, Together With a Description and Criticism of Stationary and Rotary Extractors, With Particular Reference to Their Efficiency." *Waldemar Torwald.* An illustrated description of extractors, and discussion of the uses for which each type is most suitable. Large-scale operations (except in fish and meat packing and like establishments) generally require stationary extractors, whereas the rotary type is more suited to small-scale uses. The new Schlotterhose rotary extractor is described and illustrated. *Chem.-Ztg.*, Nov. 20, 1924, pp. 853-5; Nov. 27, pp. 874-6.

"Experiences With Aluminum in the Chemical Industry." A supplement to the results of the questionnaire previously published (see *Chem. & Met.* June 30, 1924, pp. 1022-5). The substances reported on include ether, beer, potassium ferrocyanide, camphor, vinegar and acetic acid, glycerin, potassium nitrate liquors, cresols, milk, essential oils, phenols, phosphoric acid, nitric acid, alcoholic beverages, water, tartaric acid and various cooling brines. *Chem.-Ztg.*, Dec. 11, 1924, pp. 921-2.

"The Technical Explosive Properties of Liquid Air Explosives." *H. Kast* and *A. Haid.* Liquid air explosives have the greatest energy content of any explosives now in practical use. Under favorable conditions their brisance equals that of guncotton, dynamite and some of the nitro explosives, but is inferior to that of trinitrotoluene, picric acid and high-percentage dynamite. Due consideration must be given to the variability of liquid air explosives, caused by evaporation of oxygen. *Z. für angew. Chemie*, Dec. 11, 1924, pp. 973-81.

"'Moler' and Its Applications." *Paul Hannover.* "Moler" is a variety of diatomaceous earth, mined in Denmark, particularly suitable for making lightweight bricks for heat insulation, fireproof construction and like purposes. It is also an excellent substitute for sand in hydraulic cements, and for tripoli in polishing powders. *Chimie et industrie*, November, 1924, pp. 807-15.

"Improvements in Respirators." *Engelhard.* A new smoke-filtering mask and a new automatic device for regulating the oxygen supply according to the requirements of the lungs. *Chem.-Ztg.*, Dec. 29, 1924, p. 968.

"Manufacture of Moving Picture Films." *J. Soudier.* Nitrocellulose films; slow-burning or non-flammable films; use of acetylcellulose and of viscose. *Caoutchouc et Gutta-Percha*, Oct. 15, 1924, p. 12,402; Dec. 15, 1924, p. 12,486.

"Chemical Industry and the Drying Industry." *Max Winckel.* Drying milk by the spray, vacuum and hot roll processes; drying casein; separation and drying of lactose from milk. A recent development in drying casein is the Trutzer process, in which the casein is dissolved in ammonia and dried by the spray or the vacuum process. *Chem.-Ztg.*, Dec. 18, 1924, pp. 941-2.

"Zinc Losses and Recovery in Brass Foundries." *R. W. Müller.* Recovery of the zinc lost by oxidation in brass foundries would accomplish the double purpose of decreasing by at least half the total zinc loss and of increasing the available supply of zinc oxide for making zinc. A recovery process is being developed in Austria. *Chem.-Ztg.*, Dec. 18, 1924, pp. 943-4.

"The Theft of German Chemical Patents in America. *W. Kühnast.* In praise of the Attorney-General's appeal of the Chemical Foundation case, Kühnast says: "The Attorney-General's cutting criticism of Garvan's underhand dealing has a grateful sound to the German reader, and inspires the hope that the higher court will hand down a decision in harmony with a sense of justice." *Chem.-Ztg.*, Dec. 18, 1924, pp. 944-5.

"The Solubility of Nickel in Water Containing Carbon Dioxide." *Rudolf Robl.* Nickel rusts much like iron in carbonated water, with formation of a hydrated carbonate. A sample of sheet nickel (cut in 1 cm. squares) lost 0.32 per cent of its weight in 13 days in distilled water saturated with CO_2 at room temperature. *Z. für angew. Chem.*, Nov. 27, 1924, pp. 938-9.

"The Drying Process of Drying Oils." *Hans Wolff.* The drying of oils involves more than oxidation; the process is colloidal—namely, a gel formation. There are three stages: (1) oxidation with formation of a colloidal solution; (2) gel formation, and (3) further oxidation and aging. The physical and chemical properties of oil and paint films depend on degree of dispersion as well as on the chemical nature of the oil. *Chem.-Ztg.*, Dec. 4, 1924, pp. 897-9.

"Manufacture of Sodium Iodide on a Factory Scale." Application of ferrous-ferric iodide method. The precipitation is carried out in wood vats; the refining processes in enameled apparatus. *Chem.-Ztg.*, Dec. 4, 1924, pp. 899-900.

"The Use of Sand-Blasting Equipment in the Chemical Industry." *W. Kaempfer.* Illustrated description of sand blasting as a means of cleaning rust, scale, old dyes, paint and the like from metal apparatus, used iron drums, etc. *Chem.-Ztg.*, Nov. 27, 1924, pp. 873-4.

U. S. Patents Issued Jan. 27, 1925

Fused Chromite Refractory. Miner L. Hartmann, Niagara Falls, N. Y., assignor to the Carborundum Co., Niagara Falls, N. Y.—1,524,030.

Tanning Fishskin. Theodore H. Kohler, Bloomfield, N. J., assignor to the Ocean Leather Co., New York, N. Y.—1,524,039 and 1,524,040.

Food Product. Thomas C. Nixno, Chicago, Ill.—1,524,051.

Turning Plate Glass. Frank E. Troutman and Charles H. Christie, Butler, Pa.—1,524,067.

Standpipe for Coke Ovens. John H. Means, Mayville, Wis.—1,524,098.

Manufacturing Metal Dust. Minton H. Newell, San Francisco, Calif., assignor to the Alloys Co., San Francisco, Calif. —1,524,101.

Sodium Ferrous Ferrocyanide. F. W. Sperr, Jr., Pittsburgh, Pa., assignor to the Koppers Co., Pittsburgh, Pa.—1,524,113.

Coke-Oven Door. Joseph Becker, Pittsburgh, Pa., assignor to the Koppers Co., Pittsburgh, Pa.—1,524,119.

Coking Retort Oven. Joseph Becker, assignor to the Koppers Co., Pittsburgh, Pa. —1,524,120.

Forming Cellulose-Ester Materials. William Hoskins, Chicago, Ill.—1,524,133.

Aluminous Abrasive. Otis Hutchins, assignor to the Carborundum Co., Niagara Falls, N. Y.—1,524,134.

Method and Apparatus for Making Plate Glass. Floyd V. Kesselman, Butler, Pa.—1,524,179 and 1,524,259.

Evaporator. James C. Lawrence, Swarthmore, Pa.—1,524,184.

Dehydrating Secondary Butyl Alcohol. Matthew D. Mann, Jr., Roselle, N. J., assignor to Standard Development Co. —1,524,192.

Regulating Valve for Artificial Silk-Spinning Apparatus. Frederick T. Small, Spondon, England, assignor to American Cellulose & Chemical Mfg. Co.—1,524,217.

Fertilizer and Stock Food. John J. Berrigan, Chicago, Ill.—1,524,233.

Electrolyzing Fused Baths. Robert J. McNitt, Perth Amboy, N. J.—1,524,268.

Basic-Lead-Sulphate Pigment. John A. Schaeffer, St. Louis, and John H. Calbeck and Bernard S. White, Joplin, Mo., assignors to the Eagle-Picher Lead Co., Cincinnati, Ohio.—1,524,314 and 1,524,315.

Composite Article. Sandford Brown, Montclair, N. J., assignor to Bakelite Corp., New York, N. Y.—1,524,335.

Process of Heat Application. William A. Darrah, Chicago, Ill.—1,524,340.

Process of Making Olefines. Pierre E. Haynes, Buffalo, N. Y., and George O. Curme, Jr., Pittsburgh, Pa., assignors to Carbide & Carbon Chemicals Corp. —1,524,355.

Detergent. Roy L. Ginter, Tulsa, Okla., assignor to Tulsa Laboratories.—1,524,394.

Smelting Furnace. Arthur Jones, Belleville, Ill., assignor to U. S. Smelting Furnace Co., Belleville, Ill.—1,524,397.

Pickling With Sulphite Waste Liquor. Addison F. Hoffman and William M. Parkin, Pittsburgh, Pa.—1,524,435.

Chemical Process. Anson G. Betts, Kinderhook, N. Y.—1,524,472.

Process of Treating Composition Cork. Albin H. Warth, Baltimore, Md., assignor to Crown Cork and Seal Co., Baltimore, Md.—1,524,494.

Apparatus for Drying Paper. Charles S. Christie and Ernest A. Potter, Espanola, Ontario, Canada.—1,524,507.

Carboy. Charles Lefkowitz, Newark, N. J.—1,524,564.

Method of Drying Objects. William J. Plews, New Rochelle, N. Y.—1,524,567.

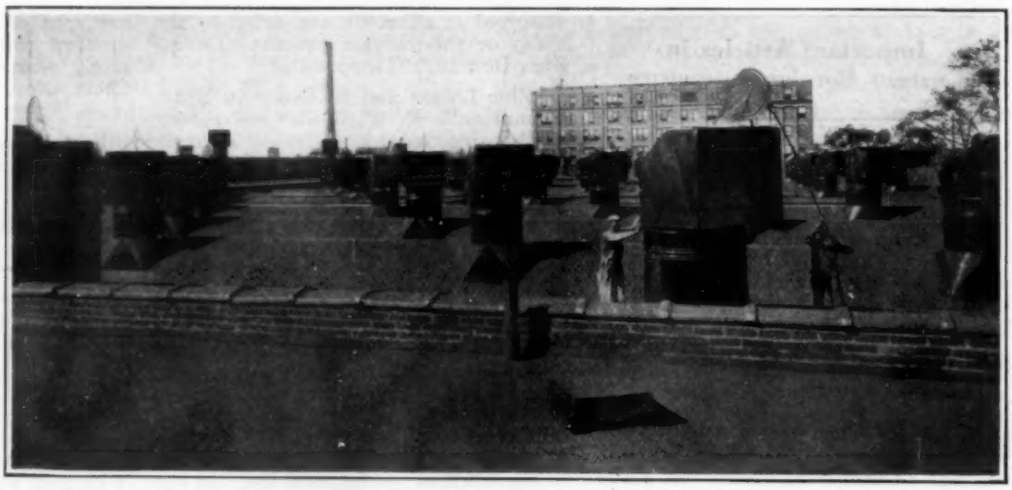
Apparatus for Treating Paper Stock. Joseph A. White, assignor to Grellet Collins, Philadelphia, Pa.—1,524,605.

Glass-Feeding Machine. Everett O. Hiller, Hartford, Conn., assignor to Hartford-Fairmont Co., Canajoharie, N. Y. —1,524,638.

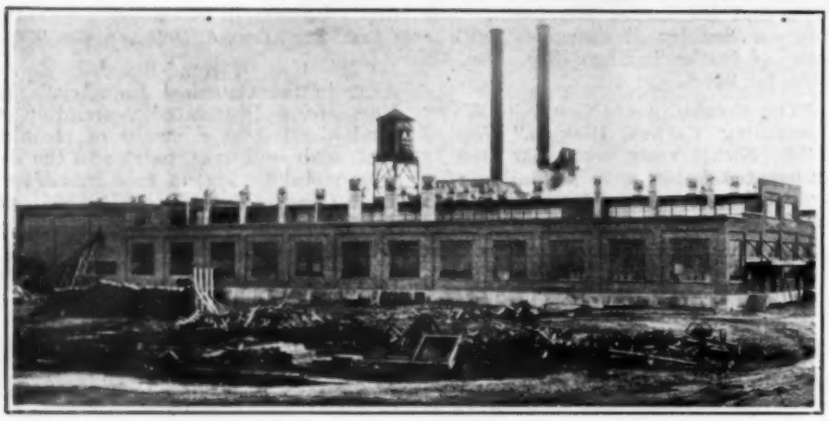
Apparatus for Handling Glass. Wilbur S. Mayers, Fairmont, W. Va., assignor to Monongah Glass Co., Fairmont, W. Va. —1,524,641.

These patents have been selected from the latest available issue of the "Official Gazette" of the United States Patent Office because they appear to have pertinent interest for "Chem. & Met." readers.

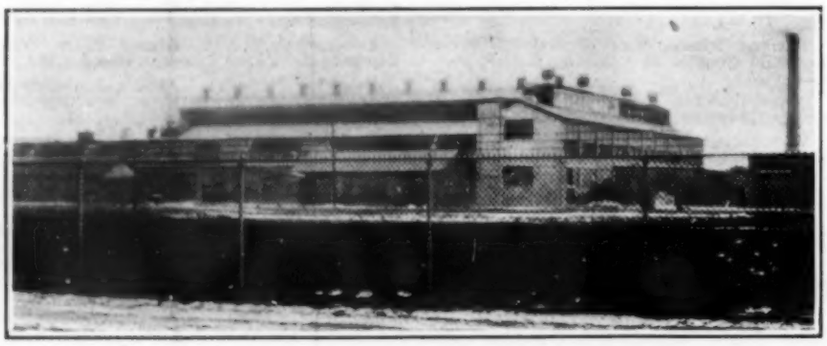
Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.



This scene, showing the roof of a great automobile factory, is a good indication of the need for ventilation in shops where men work close together for long hours.

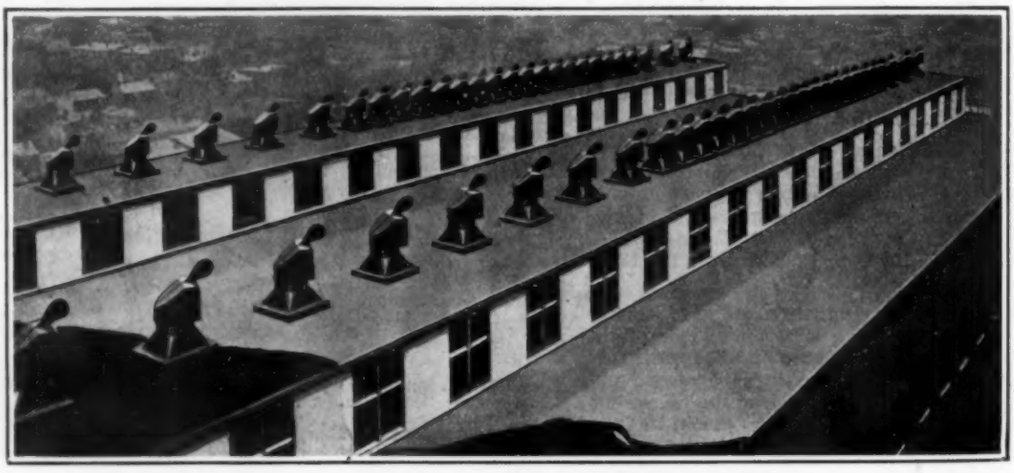


If any workroom ever needed ventilation, then the average machine-room of a paper mill is that room. This view shows roof ventilators on the machine-room of a large tissue paper plant.



One of the buildings of an important producer of aluminum, shown above, indicates that the value of pure air is also recognized in the electrochemical industries.

Another type of paper mill machine-room, one of many belonging to the world's largest producer of newsprint, is shown here. The number of ventilators used is an indication of the urgency of the need for them.



Is the Air in Your Plant Fit to Breathe?

ONE of the commonest and yet least regarded of industrial hazards is that which might be called the "lung hazard." When the manufacturing process is such that the air in the plant is rendered highly poisonous or otherwise detrimental to life, there is generally proper provision for supplying clean air to the workers. But in many of the hundreds of plants in which the atmospheric conditions are such as to promote the worker's fatigue or even to impair his health to some extent nothing whatever is done to insure a supply of fresh and healthful breathing air.

In this needed service, such institutions as banks, schools, hospitals and churches are far ahead of most industrial plants. Through experience acquired from ventilating these types of buildings, manufacturers of ventilating equipment have perfected their equipment until any demands that may develop in an industrial plant can easily be met.

There are two types of ventilating systems in general use, the roof ventilator of the rotary type and the fan system. Each has its place, and the choice in any given case should be made with care. Some fine examples of plants ventilated by rotary ball-bearing roof ventilators are shown herewith.

Equipment News

From Maker and User

Using Heavy Oils With Small Diesel Engines

By Reinhard Hildebrand
Fulton Iron Works Co., St. Louis, Mo.

In many places and at certain times in most places, the difficulty of obtaining the lighter grades of fuel oil makes it desirable that Diesel engines should be fueled with heavy oils, such as Mexican crude and "Bunker C." The larger sizes of such engines, running at low speed, give little difficulty when burning heavy oil, because the temperature in the combustion chamber is high and there is sufficient time to get the heavy oil into this chamber and burn it. With smaller units the case is different and good results are not obtained unless the design is adapted to this fuel.

In order to obtain a design for a small Diesel engine that would burn heavy oils, the writer conducted tests at the Fulton Iron Works, St. Louis, Mo., and this company is now building small Diesel engines for this service. Tests were made on a three-cylinder, single-acting, four-cycle, vertical Diesel, having 13½x19½-in. cylinders and developing 200 brake-horsepower at 257 r.p.m. When running with Mexican crude and similar oils, this engine, with the additional features used, gave good results and smokeless exhaust up to 20 per cent overload. The fuel consumption, compared with lighter oil, was in proportion to the heat content of the oil.

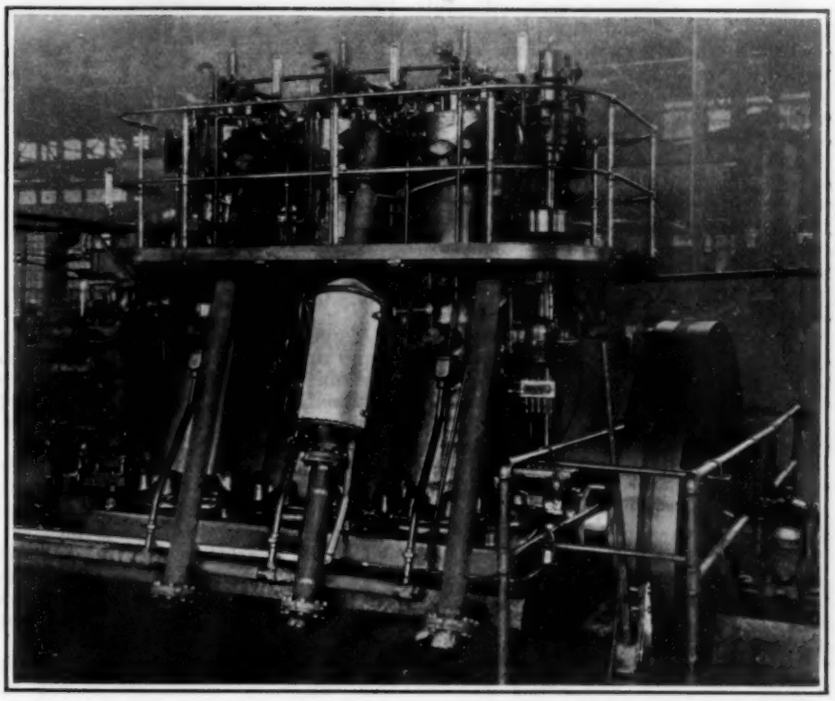


Fig. 2—Rear View of Diesel Engine, Showing Water Heater Installed on One of the Exhaust Pipes. The Water Heated in This Heater Serves to Do All the Preliminary Heating of the Oil

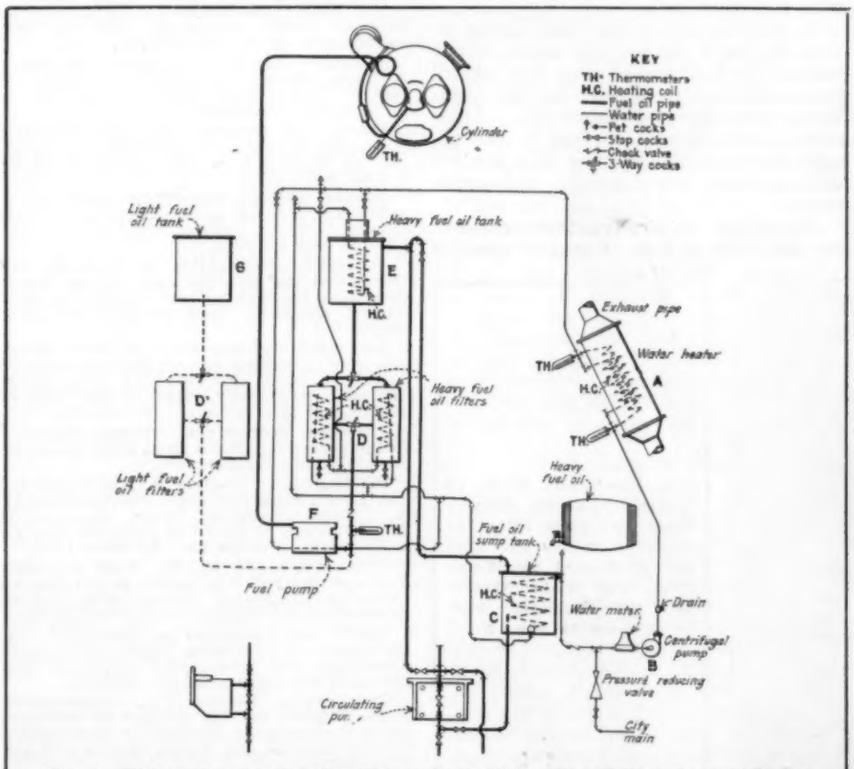


Fig. 1—Piping Plan for Burning Heavy Fuel Oil in a Small-Size Three-Cylinder Diesel Engine, Showing Location of Oil Heaters, Pumps, etc.

As the tests were conducted in cool weather, the oil had to be heated before it could be handled. The heating system heated the oil to the point where it could be handled by the circulating pump and would flow by gravity from an overhead tank through the filter to the fuel pump, where the temperature was kept constant regardless of load. The oil was heated once more before it entered the fuel injection valve, in order to lower its viscosity so that it could be atomized readily and conveyed into the combustion chamber by the injection air.

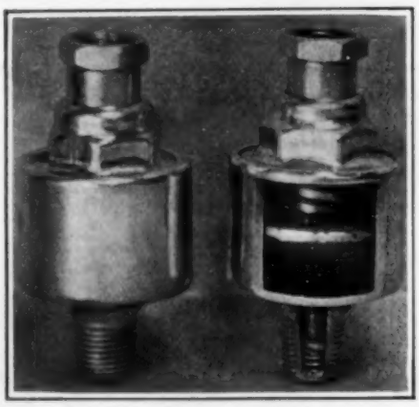
Referring to Fig. 1, the layout of this heating apparatus can be seen. A water heater, *A*, was placed in the exhaust pipe of cylinder No. 2. This contained two heating coils, so arranged that any desired temperature could be obtained at any load. This was accomplished by butterfly valves for bypassing part of the exhaust gases. Water was circulated by pump *B* and distributed through the heating coils in the fuel tank *C*, fuel-oil filters *D*, overhead service tank *E* and fuel pump *F*. The oil in the tank *C* was heated so that it could be pumped to tank *E*. This circulating pump is a standard part of the engine. The

temperature in tank *E* was increased sufficiently for the oil to flow by gravity through the twin filter, where another coil reheated it. From the filter it flowed by gravity to the fuel pump *F*, where it was kept at constant temperature by the previous heating. Between this pump and the fuel injection valve the oil passed through a heating coil located in the exhaust port.

After an exhaustive test with this layout it was found that the engine operated as well with heavy oil as with light oil. Inspection showed that it was in as good condition as if operated solely with the light oil. It operated easily and successfully under fluctuating loads down to no load, with clear exhaust, but a continuous run without load was not altogether satisfactory after the temperature of the combustion chambers corresponded to no load. These conditions, however, were improved after the compression was raised above normal (475 to 530 lb.). No difficulty was experienced in obtaining perfectly clear exhaust when the engine was operated with normal compression at one-quarter load.

The results obtained with the heavy oil were to a great extent due to proper functioning of the heating system, the proper selection of the injection pressure, atomizer plates, atomizer nozzle and some other refinements of the Fulton-Diesel. The atomizers of the Fulton-Diesel follow, in general, conventional lines; the fuel is discharged and evenly distributed on perforated atomizer plates and the injection air forces rather than siphons the fuel through the plates and nozzle into the combustion chamber.

The tests proved that smaller Diesel engines as well as large ones can burn heavy fuel oil successfully, even at fluctuating loads, provided they are properly designed and equipped with a suitable oil-heating system. It should not be inferred that all small engines built at present will handle heavy fuel oil. Unless the engine is built to burn heavy fuel oil successfully, and actually does so with a clear exhaust, it is not advisable to use heavy oil. The saving would be more than counterbalanced by increased maintenance cost and frequent shutdowns.



Automatic Grease Cup

For use with high-pressure lubrication systems employing semi-liquid lubricants.

Automatic Grease Cup

A grease cup designed to feed semi-liquid lubricants at a constant rate has been put on the market by the National Automatic Grease Cup Co., 1603 South Michigan Ave., Chicago. This cup, which is substantially made, does not replace other systems of lubrication using a force-feed gun, merely adding to them a reservoir containing sufficient semi-fluid grease or heavy oil for a period of operation greatly exceeding that possible with the use of the heavy or cup greases and insuring a constant, but not wasteful, flow of efficient lubricant to each individual bearing.

The manufacturers state that this cup can be easily applied to any machine equipped with a force-feed greasing system by simply removing the fitting, screwing the cup into place and putting the fitting on the cup, filling with the same gun.

It will be noted that the piston or stem forms a dependable gage on the degree of fullness of the cup at all times and a valve is provided for regulating the flow of lubricant. After once being adjusted to feed to the requirements of the bearing this control will operate continuously and accurately.

One of the chief advantages claimed for this cup is that it makes possible the use of semi-liquid greases and heavy oils, generally recognized as of much greater lubricating efficiency than solid greases, making it an ideal lubricator for any mechanism operating under such conditions as make it dependent upon thorough lubrication for satisfactory and economical performance.

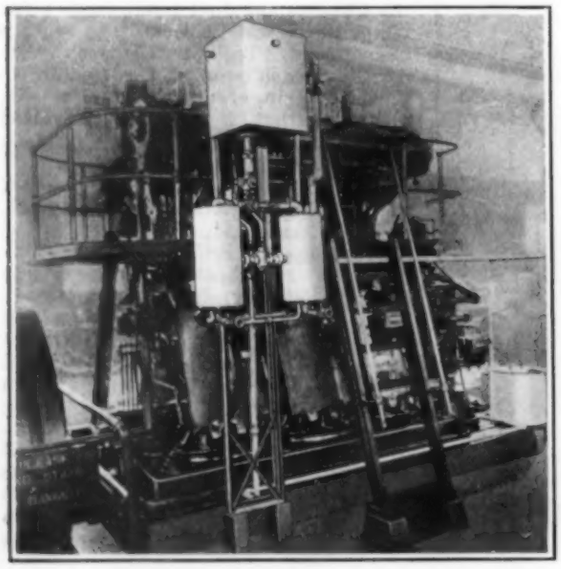


Fig. 3—Front View of Engine Showing Service Tank and Twin Filter, in Each of Which the Fuel Oil Is Heated by Water From the Water Heater on the Exhaust Pipe Shown in Fig. 2

Manufacturers' Latest Publications

Republic Flow Meters Co., Chicago, Ill.—Bulletin CM-27. A bulletin describing the Republic meter for measuring coal fed to a boiler by a chain grate stoker.

The Braun Corporation, Los Angeles, Calif.—Bulletin 424. A bulletin describing the Herman screening type ball mill.

The Cleveland Wire Cloth & Mfg. Co., Cleveland, Ohio—Catalog 2. A catalog of wire screen cloths of steel, copper, bronze, brass, nickel, monel, aluminum and other metals, also of centrifugal cloth in various metals and twilled filter cloth.

Monitor Controller Co., Baltimore, Md.—A folder describing Monitor "Edgewound" resistors.

Esterline-Angus Co., Speedway, Indianapolis, Ind.—A booklet entitled "Graphic Instruments in Industry," being an account of the use of such devices by C. R. Seaborne, formerly mill manager of the Paper Converting Corporation.

Combustion Engineering Corporation, 43 Broad St., New York—A bulletin describing a self-contained traveling grate stoker, for use in adapting existing boilers to stoker firing, in sizes ranging up to 600 b.hp.

Bailey Meter Co., Cleveland, O.—Bulletin 221. A catalog describing Type V6 meter for measuring coal and other granular material such as ore, crushed rock, cement clinker, grain, etc.

Adam Hilger, Ltd., 75a Camden Road, London, N. W. 1, England—A new general catalog of physical laboratory instruments such as diffraction gratings, spectrometers, goniometers, spectrographs, micrometers, polarimeters, etc.

A. F. Craig & Co., Ltd., Paisley, Scotland.—A folder describing hydraulic filter presses for separating paraffine wax in petroleum refineries.

The Brown Instrument Co., Philadelphia, Pa.—A folder describing electric CO_2 meters and their advantages.

Monitor Controller Co., Baltimore, Md.—A folder describing the Monitor pressure control station and "Thermaloid" starter for heating systems.

Wallace & Tiernan Co., Inc., Newark, N. J.—Tech. Pub. 56. A bulletin describing the Wallace & Tiernan Viscosimeter for testing flour.

General Electric Co., Schenectady, N. Y.—Bulletin 474951. A catalog describing oil circuit breakers, types FH-103, FH-203, FH-206 and FH-209.

Conveyors Corporation of America, 326 West Madison St., Chicago, Ill.—A folder describing the new monorail cable conveyor for coal handling, constructed by this company.

Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill.—A bulletin entitled "You Can Do It Quicker With Air," showing photographically many of the uses of compressed air.

American Blower Co., Detroit, Mich.—A folder describing direct fired heaters for industrial plant heating.

Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.—Publication 1717. A booklet entitled "The Engineering Achievements of the Westinghouse Electric & Manufacturing Co. for the Year 1924."

Griscom-Russell Co., 90 West St., New York—Form 202. A leaflet describing an instantaneous water heater using live or exhaust steam as the heating medium.

Hill Clutch Machine & Foundry Co., Cleveland, O.—Bulletin T-220. A bulletin describing the "industrial" type of spur gear speed transformer.

Connersville Blower Co., Connersville, Ind.—Bulletin 20. A catalog of cycloidal vacuum pumps as applied in paper mills to suction rolls, flat boxes, dryers and felt conditioners.

Webster Mfg. Co., Chicago, Ill.—A new edition of the bulletin entitled "Webster Method," in this case describing coal and ash handling conveyor systems.

News of the Industry

Summary of the Week

Opposition in the Senate may prevent action on Sterling-Cramton bill before Congress adjourns, on March 4.

Rapid growth in production of phosphates in Morocco threatens American export trade.

Official returns for 1924 report a loss in exports and imports of chemicals and allied products.

Committee to recommend new building to house Patent Office.

Chemical Warfare Service will be granted appropriation to continue studies of poisons for boll weevil control.

Chemical experts aid in formulating draft for Franco-German commercial treaty.

Foreign Trade in Chemicals Declined During Past Year

Official Figures Show Recessions in Both Export and Import Branches of the Industry

A STEADIER DEMAND for American chemicals and allied products by foreign countries throughout the year 1924 than in 1923 with no exceptionally large or small amounts in any single month characterized the chemical trade, which, however, showed a total loss of 6 per cent. Purchases from foreign countries were likewise less, and the rate of decrease was double that of the sales, according to an analysis by C. C. Concannon, chief of the Chemical Division, Department of Commerce.

Although the figures showing the exports of chemicals by countries for the entire year are not yet available, a study of the countries of destination for a few of the leading chemicals for the first 9 months of 1924 disclosed the fact that there was little change from the preceding year. Canada continued to be an important buyer, while in the Far East, Japan offered an outlet, with China, British India and Australia also entering into the trade to a considerable extent. Whereas the near-at-hand countries, the West Indies and Central America cannot be looked upon as large consumers of chemicals, practically all these countries purchased some chemicals from the United States.

Although the groups included under the heading "chemicals and allied products" are not entirely comparable, different commodities naturally being included under the main groups, the accompanying table illustrates most graphically the export and import trade in chemicals and allied products for the years 1923 and 1924.

Larger Imports of Coal-Tars

The foreign trade in coal-tar chemicals registered a noticeable change, with exports which amounted to $9,976,052 worth having fallen 19 per cent while imports to the value of $20,119,024 gained 16 per cent. The decline in exports was probably attributable to the loss in benzol, shipments of which went from 111,336,768 lb., valued at $3,647,660, in 1923 to 57,882,171 lb., valued at $1,739,837, while the advance in imports may be accounted for by the increase in receipts of dead or creosote oil, which went from 64,199,636 lb., valued at $10,071,393, to 89,687,784 lb., $13,463,689. While the exports of coal-tar colors, dyes and stains showed a loss of 12 per cent in quantities shipped, the values rose slightly (1.2 per cent) to $5,635,064 and were still more than $1,000,000 in excess of the imports. One-fifth more coal-tar medicinals, or $255,975, entered the country this year than last, while nearly double the amounts, or $321,766, left the country.

From the accompanying table it will be observed that the rate of decrease of the imports of industrial chemicals was decidedly higher than that of the exports, and that the latter were nearly $6,000,000 in excess of the former.

Acid Imports Decrease

Acids and anhydrides, which always have played an important part in the import trade due to the purchasing from abroad of white arsenic, tartaric acid and to a lesser extent citric, formic and oxalic acids, showed a reduction of 14 per cent from the previous year, the aggregate value of which dropped from $3,743,746 in 1923 to $3,202,409 in 1924. More than one-half of the total, or $1,591,138 (17,703,996 lb.), was comprised of white arsenic. Tartaric acid advanced in quantities received from 2,653,919 lb. in 1923 to 2,986,680 lb. in 1924, but declined in value from $641,597 to $617,140.

The exports of acids and anhydrides, which were less than one-third the imports, dropped 7 per cent in value, from $1,035,933 in 1923 to $959,362 in 1924, but rose 14 per cent in quantity, from 20,571,089 lb. to 23,473,844 lb.

The most conspicuous commodity in the import trade of industrial chemicals was crude iodine, as none of this commodity was received during 1924, whereas the preceding year 273,338 lb., valued at $887,361, entered the country.

Crude potassium bitartrate, another important import item, declined 28 per cent from the previous year to $1,094,451 (16,743,852 lb.) Not much change was made in receipts of sodium cyanide, a total of $2,658,006 (29,881,115 lb.) having entered the country in 1924.

Analysis of Export Figures

No one item stands out above the others in the export trade. The following named chemicals with the amounts exported during the year 1924 were all under those of 1923: alcohols, $900,209; aluminum sulphate, 32,024,352 lb., $407,768; ammonia and ammonium compounds exclusive of ammonium sulphate, 3,496,363 lb., $916,403; bleaching powder, 21,602,125 lb., $380,156; formaldehyde, 2,897,822 lb., $322,214; glycerin, 1,415,882 lb., $237,639; and potassium bichromate, 1,169,266 lb., $100,071. Although acetate of lime rose 5 per cent in quantity to 23,166,759 lb., the value fell 9 per cent to $733,137. Larger amounts of dextrine, or 22,190,677 lb. ($899,991), were exported in 1924 than in 1923.

A greater activity was evident in the trade in calcium carbide, and even though the exports advanced 12 per cent in values, the imports, which were approximately the same as the preceding year, were $158,936 in excess of the exports. The outgoing shipments of copper sulphate, which amounted to 2,988,039 lb. ($142,626) in 1924, a slight

rise from 1923, were just below the imports.

Exports of sodas and sodium compounds declined 14 per cent from 400,289,986 lb., valued at $9,929,286 in 1923, to 315,530,657 lb. ($8,504,430) in 1924. Foreign sales of borax receded slightly to $1,601,375 (33,741,676 lb.), while those of caustic soda failed to reach the figures for the preceding year by 25 per cent. Sodium silicate was the only compound to have shown an expansion in 1924.

Canada with one-fourth, France and Germany with one-fifth each, and Australia with one-tenth, were the leading factors in the sulphur trade, exports of which grew from $7,105,260 (472,525 tons) in 1923 to $7,786,254 (481,814 tons) in 1924.

The only classes in the explosives group to rise were blasting powder and the "all other" group. Shipments of dynamite dropped from 16,982,676 lb., valued at $2,482,562, in 1923 to 14,749,991 lb., valued at $2,201,476, in 1924.

The total imports of fertilizers and fertilizer materials in 1924, which accounted for 36 per cent of the total, showed little fluctuation from the preceding year, an advance of about 2 per cent in quantity and 4 per cent in value, although some of the items recorded rather large changes.

An improvement of 12 per cent was made in receipts of sodium nitrate, which made up 70 per cent of the total fertilizer imports and figures for which in 1924 were 986,608 tons, $47,169,496. A jump of 10 per cent in quantity but less than 1 per cent in value was made in receipts of calcium cyanamide.

While the incoming shipments of muriate of potash ($3,972,366, 128,803 lb.) and manure salts ($2,217,974, 226,144 tons) were lower than the preceding year, those of crude potassium sulphate were higher ($2,856,503, 75,657 tons). Of the other fertilizers to have diminished in values received —namely, calcium nitrate, bone phosphate, kainite and a guano—the last-named commodity was the outstanding one, with a reduction of 80 per cent to 25,245 tons, $754,683.

The exports of fertilizers and fertilizer materials in 1924, which amounted to less than one-quarter the imports, although having shown a decrease of 21 per cent in value, fell but 3 per cent in quantity.

Exports of ammonium sulphate fell short of the 1923 figure by 23 per cent in quantity and 37 per cent in value, total shipments in 1924 having equaled 118,367 tons, valued at $6,913,598, with the Dutch East Indies taking the largest share, one-third, a gain of 70 per cent over the preceding year. Japan, which country purchased more than one-quarter, dropped 60 per cent from the previous year.

Whereas the exports of phosphate rock declined from $5,772,171 (827,551 tons) in 1923 to $5,120,832 (818,773 tons) in 1924, superphosphates advanced from $534,446 (42,099 tons) to $588,620 (45,751 tons) and prepared fertilizer mixtures doubled from $832,948 (17,997 tons) to $1,695,472 (35,793 tons).

In the paint and varnish group, foreign sales throughout the last 9 months of 1924 have been steadily less than those of the corresponding period of 1923 until a 13 per cent difference, or $2,226,000, was made. Ready mixed paints other than enamel and oil varnishes were the only classes to register improvements in both quantities and values. Carbon and lamp blacks and white and sublimed lead gained in quantities shipped but diminished in values and all the other classes fell in both quantities and values.

The following figures were the amounts exported for the year 1924: Mineral earth pigments, 28,206,731 lb., $823,563; zinc oxide, 7,854,394 lb., $605,630; lithopone, 1,845,073 lb., $104,783; bone black, 1,971,857 lb., $123,201; carbon and lamp blacks, 34,428,855 lb., $3,385,852; red lead and litharge, 1,880,263 lb., $210,598; white and sublimed lead, 10,109,455 lb., $853,444; other chemical pigments, 5,156,313 lb., $614,385; enamel paints, 1,874,598 lb., $483,079; other ready mixed paints, 2,015,849 gal., $4,029,931; all other paints, 8,383,119 lb., $1,485,066; oil varnishes, 652,312 gal., $1,122,982; and all other varnishes, 283,835 gal., $483,686.

The imports of pigments, paints and varnishes likewise showed a drop and amounted to $2,822,702 in 1924, 45 per cent of which was made up of chemical pigments and 37 per cent of mineral earth pigments.

Slightly heavier shipments of naval stores, gums and resins, $25,653,958 in all, which accounted for nearly one-fifth of the total exports, were made in 1924 than in 1923. The total foreign sales of rosin during 1924, amounting to 1,452,387 bbl., valued at $13,754,790, surpassed those of 1923 by 24 per cent. Although the quantity of spirits of turpentine which left this country for foreign countries rose from 11,478,459 gal. in 1923 to 11,510,154 gal. in 1924, the value fell from $12,303,809 to $10,105,015.

The imports of gums, resins and balsams reflected a marked reduction—33 per cent—during the year 1924 as compared with 1923, having receded to $28,746,464. All of the classes included under this heading dropped in quantities entering this country, varnish gums having diminished from 95,641,419 lb., valued at $30,417,720, in 1923 to 67,869,690 lb., $19,843,426; crude natural camphor, from 3,486,082 lb. ($2,214,008) to 1,847,785 lb. ($998,832); refined and synthetic camphor from 4,002,243 lb. ($2,880,883) to 2,861,654 lb. ($1,781,417); and gum arabic from 9,857,703 lb. ($1,239,788) to 7,306,795 lb. ($782,462).

Eighteenth Supplemental List of Dye Standards

The Treasury Department has issued its eighteenth supplemental list of standards of strength of coal-tar dyes, for the purpose of assessing the specific duty of 7 cents a pound, which is applied in the proportion that the strength of the importation bears to the strength of similar commercial imports prior to July 1, 1914. This latest list adds fifteen dyes to the standards, names twenty-two others for similitude to colors previously listed and makes two corrections in prior lists.

Plan to Increase Production of Chemicals in Russia

While the value of chemicals produced in Russia in 1924 was not greatly in excess of the total for its 1923 production, plans for 1925 provide for a much greater output. According to a German analysis of the chemical situation in Russia the intention is to increase superphosphate production by 80 per cent, acids by 25 per cent and salts by 20 per cent.

Most chemicals which have been produced in Russia have been absorbed readily. Russian-made superphosphate has been a drug on the market because of the preference for the foreign product, but this situation has been met by an official decree requiring priority in the use of the domestic product. The output of copper sulphate has been limited by the shortage of copper in Russia.

Dr. Baker to Lecture on Chlorine in Sewage Disposal

Dr. J. C. Baker, chief chemist of Wallace & Tiernan, Newark, N. J., will speak on Feb. 10 at Niagara Falls, N. Y., before a joint meeting of the Western New York sections of the American Electrochemical Society and the American Chemical Society. His subject will be "The Use of Chlorine in Sewage Disposal." This is a subject of vital interest to a large number of chemists in Niagara Falls, especially those connected with the manufacture of chlorine. It is expected that a large number will gather to hear Dr. Baker, who has had extensive practical experience in utilization of chlorine.

Exports and Imports of Chemicals

	Exports		Per Cent Incor. Dec.	Imports		Per Cent Inc.or Dec.
	1923	1924		1923	1924	
Coal-tar chemicals	$12,331,666	$9,976,052	—19	$17,273,682	$20,119,024	+16
Industrial chemicals	26,799,671	24,221,596	— 9	24,382,516	18,226,566	—25
Sulphur	7,105,260	7,786,254	+10	.....	.....	....
Explosives	3,535,705	2,889,699	—18	.....	.....	....
Fertilizers and materials	20,794,077	16,506,874	—21	63,912,822	66,531,495	+ 4
Pigments, paints and varnishes	16,551,725	14,326,200	—13	3,306,976	2,822,702	—15
Naval stores, gums and resins	25,177,136	25,653,958	+ 2	.....	.....	....
Gums, resins and balsams	.....	.....	....	43,201,964	28,746,464	—33
Essential oils	1,012,027	1,674,930	+65	5,560,004	5,527,829	— 4
Crude drugs, herbs, leaves, etc	3,543,222	4,040,109	+14	8,727,035	8,122,674	— 7
Medicinal and pharmaceutical preparations	16,176,934	17,440,638	+ 7	5,444,300	4,776,943	—12
Perfumery and toilet preparations	6,878,683	7,252,050	+ 5	5,612,789	5,807,669	+ 3
Chinawood oil	.....	.....	....	13,397,000	11,091,776	—17
Total	146,147,639	137,551,482	— 6	207,293,757	182,188,156	—12

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Focusing Industry's Attention on Economic Marketing

McGraw-Hill Company Convention Gives Searching Study to the Means of Eliminating the Wastes of Distribution and Sales

THE industrial press plays an important part in the great national program for eliminating waste in the distribution and sale of the products of industry. It was appropriate, therefore, that economic marketing should form the general theme of discussion at the convention of the business and editorial staffs of the McGraw-Hill Co., held at the Hotel Pennsylvania, New York City, Jan. 28 to 30. More than 300 representatives of the fifteen industrial and engineering publications of the McGraw-Hill Co. participated in the round-table and group discussions. To these meetings was also brought the opinion of such leaders of economic thought as Herbert Hoover, Secretary of Commerce, and Julius Barnes, past-president of the Chamber of Commerce of the United States, and of such outstanding industrialists as W. L. Batt, president of the S K F Industries, Inc., David Sarnoff, vice-president and general manager of the Radio Corporation of America, and Fred I. Kent, vice-president of the Bankers Trust Co.

Promoting Efficient Selling

At the opening session on Jan. 28, James H. McGraw, president of the McGraw-Hill Co., struck the keynote of the convention in heralding a new era of sales development. That development is to be marked by more efficient service, based primarily on better knowledge of marketing problems. Much the same theme was also emphasized by Mr. Batt, who interpeted his subject, "Creative Selling," to mean, in effect, "helpful selling." He made clear the definite need industry has for the information and guidance of the industrial press.

"If you cannot help the man you want to sell," said Mr. Batt, "you might as well figure that most of your time and his is wasted. You have no reason, and a representative has no reason, to take a prospective customer's time unless he can give him something valuable in return for it."

The speaker gave details as to the customer's need of help from the salesman and cited the importance of a knowledge by the salesman of the product his prospect manufactures and sells.

"The Publisher's Representative From a Buyer's Point of View" was the subject discussed by P. L. Thompson, advertising director of the Western Electric Co. and a past president of the Association of National Advertisers. He showed the importance of co-operation between the publication and the advertiser, so that the advertiser may realize to the fullest extent the benefit the expert assistance that may be given him by the industrial and business paper.

Malcolm Muir, vice-president of the McGraw-Hill Co., in outlining the objective of the convention, showed how the resources and broad knowledge of industrial fields possessed by the business press could be of maximum use in solving the problems of industrial marketing. The McGraw-Hill Co.'s nation-wide survey of the buying habits of industry formed the basis of much of the discussion that followed on market analysis, and the scientific study of sales programs.

Mr. Barnes on "Economic Marketing"

The climax of the convention, however, came at the banquet on Jan. 30 when Fred M. Feiker, vice-president of the Society for Electrical Development and formerly assistant to the Secretary of Commerce, read the accompanying letter to Mr. McGraw from Herbert Hoover. Mr. Barnes then discussed "Economic Marketing" and the growing complexity in the relation of government to industry and to the individual. After all, it is the inventive genius, the initiative and the resourcefulness of the individual that in the past have measured the material progress of this country. In the future team work and concerted action must be expected if greater industrial efficiency is to be attained. Mr. Sarnoff cited the radio industry as exemplifying "Opportunity" in American industry. In the few years of its existence radio rivals many older industries; it already surpasses the phonograph and is fast taking a place with the automobile as typical of the large-scale development of American ingenuity.

E. J. Mehren, vice-president of the McGraw-Hill Co. and directing head of the group of engineering publications to which *Chem. & Met.* belongs, used his official prerogative as toastmaster to sum up the accomplishments of the convention and to emphasize the importance of carrying on the service to industry that has been initiated and so efficiently developed under the leadership of James H. McGraw.

A Tribute From Mr. Hoover

DEAR MR. MCGRAW: I wanted to attend your convention to say a personal word of appreciation for the fine service which you, your company and your publications are rendering to American industry. It is a real disappointment to me that I cannot come.

A big change has come in the spirit of American business, and for this change you are in part responsible. I mean the change from rule of thumb and *laissez-faire* to scientific determination of facts and program of action based on facts. The business press is probably the greatest force in making industrial opinion. The schools and colleges have an important place, the trade associations can do much in the fields of production and distribution, the government bureaus that keep in contact with business can help to promote sound leadership in industrial and economic thinking. All have an important place, but the business press and technical journals are in a unique position and have a unique opportunity. I believe that no organization of technical publications has come nearer to living up to this opportunity than the McGraw-Hill publications under the leadership of James H. McGraw.

The thought I have in mind is that your great group of journals can not only recognize and support sound industrial leadership; you can also initiate it. The field of your opportunity is practically limitless. HERBERT HOOVER.

Washington News

Committee to Recommend New Building for Patent Office

The Committee on Patent Office Procedure, appointed some weeks ago by the Secretary of the Interior to make a study of the Patent Office methods and procedure, has been actively at work. At a recent meeting it came to some final decisions. It is the opinion of the committee that the essential difficulty with the Patent Office is the lack of adequate and well-adapted space. The building in which it is housed was designed and built with the primary objective of displaying models of patents and as an industrial arts museum. In the early history of the Patent Office this building afforded fairly satisfactory office room, in addition to the space designed for museum purposes. However, the personnel has long since outgrown all working floor space with the result that desks and files have been put in the basement, attic, and hallways.

It was the realization of these facts that caused the committee to recommend that an effort should be made to have assigned immediately to the Patent Office such additional space in the Land Office Building as required for a number of new divisions and to provide for the probable growth during the next 4 or 5 years, and further that the federal government be urged at the earliest possible moment to design, build and equip a modern office building for the Patent Office, the building to be designed for the special needs of the Patent Office and of ample capacity to provide for the normal growth thereof for some years to come.

Action on Sterling-Cramton Bill May Be Deferred

A more stormy path confronts the Sterling-Cramton prohibition bureau bill in the Senate than appeared possible a few weeks ago, in view of developments within the last week.

The minority report drafted by Senator Reed of Missouri in opposition to administrative powers which the bill seeks to confer upon the commission of prohibition in itself affords an opportunity for opponents of the measure to make a hard fight on the floor. In view of the legislative situation in the Senate, with many bills being pressed for action before the present Congress expires March 4, serious opposition by even a few members to any bill places it in danger.

But in addition to this, Senator Couzens of Michigan desires that action on the Sterling-Cramton bill be deferred until the special committee, of which he is chairman, which has been investigating the Bureau of Internal Revenue can submit a report embodying suggestions regarding changes in the Prohibition Unit. For the last month the Couzens committee has been conducting an inquiry into administration of the Unit.

While the amendments agreed upon by the Judiciary Committee are said to satisfy the wholesale and retail druggists and the proprietory medicine interests, the opposition of the industrial alcohol consumers to the Sterling-Cramton bill continues. The bill seeks to elevate the present Prohibition Unit to the rank of an independent bureau of the Treasury Department.

C.W.S. Will Continue Study of Boll Weevil Poisons

By a Senate amendment to the War Department appropriation bill, to which the House has agreed, the Chemical Warfare Service is given $25,000 with which to continue and complete its studies of poisons with which to combat the cotton boll weevil. The Chemical Warfare Service has been conducting investigations and experiments with various gases and poisons in an effort to find a more effective agent than calcium arsenate for use in the cotton fields of the South. More than 130 different poisons already have been the subject of these experiments. While no definite results have been obtained, officials of the Service are hopeful of success before the experiments end. The work is conducted in co-operation with the Department of Agriculture.

Rapid Advance in Phosphate Output of Morocco

In producing 436,000 tons of phosphate in 1924 the French in Morocco exceeded their own estimates by nearly 10 per cent. The 1923 production was 190,632 tons; that of 1922, 80,549 tons and that of 1921, 8,232 tons. Production this year is expected to exceed that of 1924 by 150,000 tons.

Despite this great increase in Moroccan production it seems to have had no important effect on the foreign markets where most of the American phosphates are sold. German purchases of American phosphate are increasing, as are those of Japan—our best two customers. Germany seems to have taken little of the Moroccan product, while none has gone to Japan. Apparently most of the Moroccan output is going to nearby countries. France is responding generously to the propaganda looking to the use of its own fertilizer material. Intensive sales efforts are being put forth in other countries, to good effect in Spain, Belgium, Italy and other nearby territories, but with indifferent success in those further away.

Apparently the American producers are going to be able to retain most of the Far East market. The Moroccans have a considerable geographical advantage with respect to the German market, but the Germans are more inclined, as long as prices are comparable, to buy their phosphate from its best potash customer. There was talk last fall of an agreement between Germany and France which in effect would reserve the German market for Moroccan phosphate. In the meantime, however, it has been revealed that Germany has had no thought of such an arrangement and is more inclined to enter into plans calculated to increase its potash sales in the United States. Her inclination is much more toward saying to the United States, "You take my potash and I will take your phosphates" than it is toward addressing such a proposal to France.

Despite statements to the contrary, it is believed that negotiations are in progress between the Potash Syndicate and the American phosphate producers looking to an exchange of potash for phosphate. It can be stated positively that such a proposal has been made by the Potash Syndicate and it is believed that the American phosphate interests still are considering it despite their hesitancy in making a definite decision as to the course to pursue.

Manufacture of Nitrogen in Norway

The *Journée Industrielle* of Paris quotes a report from Berlin that the Badische Anilin und Sodafabrik is negotiating with the Norsk Hydro with a view to the resumption by the latter of the manufacture of nitrogen in Norway. The factory belonging to the Norsk Hydro, which was installed with the collaboration of the Badische Anilin, used the Eyde process of manufacture, which has now been superseded by the German methods. However, since the Norsk Hydro has at its command a large and cheap hydraulic force an inquiry is now taking place as to the possibility of reorganizing the production at the works. The German company appears to be endeavoring, above all, to regulate the nitrogen market, for, in spite of the importance of home consumption it exports a considerable amount.

Chemical Experts Work on Franco-German Treaty

The German chemical experts who are assisting in the drafting of the Franco-German commercial treaty are busy preparing counter proposals intended to moderate the effect of the French proposal to place 300 chemical products on her dutiable list, says C. E. Herring, the American Commercial Attaché in Berlin. It will be recalled that the German experts walked out of the conference in Paris when the French handed in their chemical list. They since have been working on counter proposals in Berlin. The German chemical experts assigned to work on the treaty include: Herr Kommerzienrat, Dr. Frank and Dr. Ingewitter. Carl von Weinberg and V. Schnitzler participated in the conferences on dyes.

German Potash Sales Declined

German potash sales during the last half of 1924 are reported to the Department of Commerce as having been 514,393 tons K_2O. This brings the total for the year to 841,900 tons. This is 44,000 tons less than sales in 1923 and nearly half a million tons under 1922 sales.

News in Brief

Hydrocyanic Acid Gas Used in Control of Hide Beetle—The substitution of hydrocyanic acid gas fumigation for the use of sprays, naphthalene, paradichlorbenzene, and heating, in hide and skin warehouses, for the control of the hide beetle, has been a complete success, it is claimed. It has been demonstrated by the Bureau of Entomology of the federal Department of Agriculture that such fumigation does not injure delicate skins or hides and has no effect on the tanning process.

Chemical Plant Expansion — The Mathieson Alkali Works, Inc., New York, is perfecting plans for expansion at its plants at Niagara Falls, N. Y., and Saltville, Va., covering a construction and improvement program requiring about 24 months time and a gross expenditure of about $2,500,000. The work includes extensions at the Niagara Falls works for considerable increased output of liquid chlorine, as well as the establishment of facilities for the manufacture of synthetic ammonia under a new process, now in course of ultimate development, utilizing byproducts. The Saltville plant will be remodeled in a number of departments and improvements made in equipment, as well as additional apparatus for increased manufacture.

High-Grade Ocher Bed in Canada—Five mineral claims have been filed in the Edmonton, Alta., dominion land office on what is believed to be the largest bed of high grade ocher yet discovered in Canada, engineers who have seen the deposit claiming that the quality of the material surpasses anything yet brought to light. The discovery was made by Dr. D. P. Dooley of Edmonton, on his homestead on the line of the Alberta and Great Waterways Railway. The mineral is 4 ft. thick in places and according to an engineer who was employed to make a report, there is at least 14,000 tons in sight.

American Institute of Chemical Engineers to Go to England—The date for the meeting in England of the American Institute of Chemical Engineers has finally been decided upon. Tentative reservations have been made on steamers reaching Liverpool Sunday, July 12. The program consists of meetings with various British societies and excursions from July 13 to 23, with a 3 weeks trip on the Continent for those who can spend additional time in Europe. Those contemplating taking the trip are urged to communicate immediately with J. C. Olsen, secretary, 85 Livingston St., Brooklyn, N. Y., as passenger lists on steamers at this time of year are large and reservations must be made some time in advance.

"Chemistry in Industry" at College of the City of New York—Dr. F. E. Briethut, professor of chemistry at the College of the City of New York, began a course of five lectures on "Chemistry in Industry" at the college on Friday evening, Feb. 6. This course of lectures is being given under the auspices of the Salesmen's Association of the American Chemical Industry and will be open to all interested upon payment to the association of the proper fees. The lectures will deal with the following subjects: Feb. 6, Foundations of the Chemical Industry; Feb. 13, Coal, Coke and Their Byproducts; Feb. 20; Abrasives, Refractories and Glass; Feb. 27, Iron, Steel and Their Alloys; March 6, Petroleum.

Cyanamid Co. Purchases Mine in Nova Scotia.—The American Cyanamid Co. has purchased the Stirling Zinc mine in Cape Breton, N. S., on which substantial work has been done, disclosing ore carrying zinc, copper and a few dollars in gold and silver. The American Cyanamid Co. will also establish a smelter on the north shore of the St. Lawrence in the Province of Quebec, at a point near the mouth of the Saguenay River.

Suits Between Flow Meters Companies Settled Amicably

The following announcement has been made by the Republic Flow Meters Co., and is self-explanatory:

"The suit brought by Brown Instrument Co. in the federal court at Chicago against Republic Flow Meters Co. and certain individuals has been settled between the parties; also certain suits at law brought by Republic Flow Meters Co. and the same individuals in the same court against Richard P. Brown have been dismissed.

"The officers of Republic Flow Meters Co. did not wish to be under the imputation of illegally using any of the original constructions of the Brown Instrument Co. It having been called to their attention that there were pending on behalf of Brown Instrument Co. patent applications covering some of these features, to avoid controversy the Republic Flow Meters Co. has changed the construction of its indicating and recording pyrometers announced by it to avoid any question of infringement either of patents or of original designs or construction of the Brown Instrument Co."

Columbia to Give Extension Course in Textile Chemistry

A course in textile chemistry, with Benjamin B. Underhill as instructor, will be given in University Extension at Columbia on Tuesday evenings during the spring term. The work beginning Feb. 10, will embrace the chemical analysis and dyeing of the various textile fibers and will include both laboratory effort and lectures.

The outline includes chemical analysis of textile fibers, their scouring, bleaching and quantitative analysis; conditioning and carbonizing of wool, mercerizing, theory and methods of dyeing and testing the fastness of colors.

Carbonization Tests Planned

The American Gas Association technical section has tentatively approved plans for the testing of certain typical coal-carbonizing plants. It is expected that a 1-month test run will be made on each of these different types of coal-carbonizing equipment. The results, it is hoped, not only will supply the operating men with more reliable data on the comparative operation of the plants but will indicate the value of the test code and any change necessary in its present form.

The tentative list of plants suggested for this test is as follows: Woodall Duckham Continuous Verticals, Buffalo, N. Y.; U. G. I. Intermittent Verticals, Rochester, N. Y.; Koppers Coke Ovens, Utica, N. Y.; Glover West Continuous Verticals; Semet Solvay Coke Ovens; Horizontal Retorts.

Industrial Notes

The Roller-Smith Co., 233 Broadway, New York City, announces the appointment of W. H. Pugh as its representative in the northeastern part of Pennsylvania, with headquarters at its factory at Bethlehem, Pa.

William H. Utz, vice-president and formerly European director of Jenkins Bros., Ltd., with headquarters in London, England, has been made director of sales of Jenkins Bros., 80 White St., New York, valve manufacturers. He assumed his position on Jan. 1, and will have general charge of the selling activities of the company.

The Hydrotator Co., a newly formed corporation, has acquired the patents and engineering business of L. C. Trent, who has been operating as the L. C. Trent Engineering Co. in Philadelphia. Mr. Trent has retired from the business except for a limited territorial arrangement on the Pacific coast. Neither the Hydrotator Co. nor its predecessor, the L. C. Trent Engineering Co., is in any way affiliated with the Trent Process Corporation, the Trent Superfuel Co. or the Pittsburgh Trent Co., which produce so called "Amalgam" from a mixture of oil and pulverized coal. The Trent patents purchased by the Hydrotator Co. cover entirely different processes, one of which deals with the cleaning of coal by classification and flotation. Walter L. Remick, formerly engineering editor of *Keystone Mining Catalogs*, will assume active management of the Hydrotator Co. after Feb. 1. Mr. Remick is an engineer of wide and varied experience, especially along research lines. Any problems involving precipitation of solids from liquids by addition of gases, liquids or solids; washing and decanting of precipitated solids, dissolving one or more solids from a mixture of chemical compounds and discharging in any predetermined state of saturation, dissolving, precipitating, agitating, filtering, thickening, classification and separation—in general, the treatment of any class of solids mixed with or in suspension in liquids—will receive the prompt and careful attention of this organization. The general offices of the company are located at 1328 Chestnut St., Philadelphia, Pa.

Men You Should Know About

JEROME ALEXANDER delivered an address on Jan. 23 before the Toronto section of the Society of Chemical Industry upon "Colloid Chemistry in Meat Packing," and on the 26th he spoke on "Milk and Milk Products" before the Ottawa section. On the 27th he gave a lecture on "Colloids" to the students of Queen's University, Kingston, Ont.

LLEWELLYN T. BACHMAN, formerly directing chemist and superintendent for the Santa Cruz Portland Cement Co., Davenport, Calif., has become connected in a similar capacity with the Petralta Portland Cement Co., San Francisco, Calif.

A. A. BEARD, superintendent of production for the Tidal Oil Co., Tulsa, Okla., has been appointed general manager of the company. He has been connected with the company for about 10 years.

SAMUEL B. BOWEN of Philadelphia, Pa., has been re-elected president of the Pecora Paint Co., of that city. SAMUEL B. BOWEN, JR., was elected vice-president; JOHN H. JOHNSON, secretary; and JOHN J. SCHISSELBAUER, treasurer.

HIRAM S. BROWN, president of the Central Leather Co., New York, gave an address on the subject of sole leather before the members of the National Association of Boot and Shoe Manufacturers at New York, Jan. 20.

WILLIAM E. CURRAN, heretofore assistant superintendent of the byproduct coke plant of the Republic Iron & Steel Co., Youngstown, Ohio, has been appointed superintendent of the new coke works of the company now in course of construction at Birmingham, Ala.

VANCE P. EDWARDES, in charge of sulphite investigations in the pulp and paper section of the Forest Products Laboratory, 1917-1921, has rejoined the laboratory after 3½ years in the employ of the Interlake Division of the Consolidated Water Power & Paper Co. at Appleton, Wis. When Mr. Edwardes joined the Consolidated Water Power & Paper Co. forces he was placed in charge of the organization of a laboratory to develop methods of control and standardization of mill operations. For 2½ years he was in charge of the sulphite department, further developing control methods of both quality and production. In 1924 Mr. Edwardes made a trip to Norway and Sweden as a representative of his company to study methods used there in the sulphite process, particularly in the cooking and handling of pulp and in steam conservation. His new position with the Forest Products Laboratory involves liaison work with the pulp and paper industry. He is at present occupied with the promotion of better white water utilization from both the standpoint of conservation of valuable materials and stream pollution.

ARTHUR H. FLEMING succeeds the late Dr. Norman Bridge as president of the board of trustees of the California Institute of Technology.

E. M. K. GEILING, of Johns Hopkins University, addressed members of the Southern California section of the American Chemical Society at Los Angeles on Jan. 28, taking as his subject "The Chemical and Physiological Properties of the Secretions From Internal Glands."

ABEL HANSEN, president of the Fords Porcelain Works, Perth Amboy, N. J., has been re-elected president of the Fords National Bank, Fords, near Perth Amboy, N. J.

C. H. HAUPT, chief engineer for the Standard Oil Co. of New Jersey, acted as toastmaster at a dinner of members of the general engineering department of the company and their guests at the Newark Athletic Club, Newark, N. J., Jan. 28.

F. M. HODGE has been re-elected president of the Kalamazoo Paper Co., Kalamazoo, Mich.

J. C. KEANE, formerly assistant superintendent of the Utah-Idaho Sugar Co., Salt Lake City, Utah, has become a member of the staff of the Bureau of Chemistry, Department of Agriculture, and will be stationed at Washington.

Calendar

AMERICAN CERAMIC SOCIETY, annual meeting, Columbus, Ohio, Feb. 16 to 21.

AMERICAN CHEMICAL SOCIETY, New York Section, March 6.

AMERICAN CONCRETE INSTITUTE, annual meeting, Chicago, Ill., Feb. 24 to 27.

AMERICAN ELECTROCHEMICAL SOCIETY, Niagara Falls, April 23 to 25.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, Providence-Biltmore Hotel, Providence, R. I., June 22 to 25.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, annual meeting, New York City, Feb. 16 to 19.

AMERICAN PULP AND PAPER MILL SUPERINTENDENTS ASSOCIATION, Niagara Falls, N. Y., June 4 to 6.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 22 to 26.

CHEMICAL EQUIPMENT EXPOSITION, Association of Chemical Equipment Manufacturers, State Armory, Providence, R. I., June 22 to 27.

BRUSSELS INTERNATIONAL AND COMMERCIAL FAIR (sixth), Brussels, Belgium, March 25 to April 8.

NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES, New York, Sept. 28 to Oct. 3.

SOCIETY OF INDUSTRIAL ENGINEERS, national convention, Hotel Winton, Cleveland, Ohio, May 6 to 8.

SOUTHERN EXPOSITION, Grand Central Palace, New York, May 11 to 23.

WILLIAM JANNEY, who has been marketing a line of chemicals used in the jewelry trade, is now connected with the Standard Oil Co. as chemist at its Sugar Creek, Mo., refinery.

D. B. KEYES of the Research Laboratory of the U. S. Industrial Alcohol Co., Baltimore, Md., spoke before the local section of the American Chemical Society, Jan. 9, on "The Training of Chemical Engineers" substituting for Carl Haner, who was mentioned in our issue of Jan. 26 as having spoken on "Some Wild Engineering I Have Known."

E. J. KULAS has been elected president of the Otis Steel Co., Cleveland, Ohio, to succeed George Bartol, resigned.

WILLIAM H. LAUSTERER has been elected second vice-president and a member of the board of directors of the Jamestown Malleable Products Co., Jamestown, N. Y., succeeding his father, William J. Lausterer, deceased.

EDWARD MALLINCKRODT, president of the Mallinckrodt Chemical Works, St. Louis, Mo., celebrated his eightieth birthday on Jan. 21. He was the guest of honor at a dinner given on that date by a number of friends at the local Bogey Club.

T. T. MUNGER is director of the Pacific Northwest Forest Experiment Station, headquarters for which have been established in the Lewis Building, Portland, Ore. The station will take charge of research work in forestry in Washington, Oregon, southern Idaho and southern Alaska. Technical associates with Mr. Munger are L. A. Isaac, R. E. McArdle and A. G. Simson.

H. Z. E. PERKINS, chemist of the American Sugar Refining Co., New York, gave an interesting and instructive address before the members of the Louisiana Section of the American Chemical Society at the Louisiana State Museum, New Orleans, on Jan. 16, dealing with the clarification of refinery sirup.

W. D. POLLOCK, heretofore factory manager of the Macbeth-Evans Glass Co., Charleroi, Pa., has been appointed superintendent at the plant, succeeding Louis P. Flickinger, resigned. LAMBERT HEATON has been appointed factory manager to succeed Mr. Pollock.

ROBERT REED, chemist in charge of the Lake Laboratory, technical laboratory of the du Pont Dye Works, a division of E. I. du Pont de Nemours & Co., Wilmington, Del., has resigned, effective March 1, to take charge of the research work of the Lithographic Technical Foundation of the University of Cincinnati, recently formed by the National Association of Employing Lithographers. Mr. Reed has been connected with the du Pont organization for the past 5 years, and is a graduate of the University of Cincinnati.

GEORGE A. RICHARDSON of the Bethlehem Steel Co., Bethlehem, Pa., gave an address on the subject of the min-

ing of iron ore and the manufacture of steel, illustrated with motion pictures, before the members and guests of the Bethlehem Industrial Club, at the Liberty High School, Bethlehem, Jan. 16.

Prof. ALEXANDER SILVERMAN, head of the department of chemistry, University of Pittsburgh, gave an interesting address recently at the Carnegie Museum Lecture Hall of the same city, on the subject of artificial silk, termed "The Silk Worm's Competitors."

C. C. STOLL, president of the Stoll Oil Refining Co., Louisville, Ky., has left for a trip to California, accompanied by Mrs. Stoll.

W. G. TAGGERT, assistant director in charge of the Sugar Experiment Station, New Orleans, La., has left for a 6 weeks inspection tour of the West Indies, including Cuba, Porto Rico and Barbados, to investigate conditions in the sugar industry, especially with regard to different varieties of sugar cane and cane diseases.

At a meeting of the Glass and Pottery Manufacturers Association at Pittsburgh, Pa., CHARLES H. WEST, of Grapeville, Pa., was re-elected president. Other officers for the ensuing year are: D. HARRY CUSHWA, United States Glass Co., Pittsburgh, vice-president; C. L. SEBRING, Sebring, Ohio, secretary; and G. S. BRUSH, Zanesville, Ohio, treasurer.

Obituary

CHARLES B. BECKWITH, president of the Beckwith-Chandler Co., New York, paints and varnishes, died at his apartments in the Hotel Woodward, Jan. 19, of heart disease. He was 62 years of age.

Colonel CHARLES M. DUPUY, president of the Pennsylvania Rubber Co., Jeannette, Pa., died at Albuquerque, N. M., Jan. 25, of pneumonia, contracted while en route to join a camping party in Arizona. He served overseas in the World War, advancing to the rank of Colonel.

C. A. GRAY, vice-president of the Sinclair Refining Co., Chicago, Ill., died suddenly at Kansas City, Mo., Jan. 21, due to heart trouble. He was widely known in the petroleum industry and was formerly an official of the Chanute Refining Co., later purchased by the Sinclair interests.

Dr. NATHANIEL SHEPARD KEITH, noted metallurgist and scientist, died suddenly of heart disease at Philadelphia, Pa., Jan. 27, aged 87 years. He was born at Boston in 1838, and in 1860 started practice as a metallurgical engineer in Colorado. Later he became interested in the electrical field and invented a number of appliances; he was an associate of Thomas A. Edison in the latter work.

France Gives Bonus to Users of Artificial Fertilizers

As a means of popularizing and encouraging the use of artificial fertilizers in France, bonuses will be granted farmers making use thereof. Owing to the increased demands for such fertilizers during the past weeks the French Government has found it necessary to import additional supplies from Germany.

Linseed Oil Mills Active

Linseed oil plants in Minnesota report an unusually active season, and are now crushing about 40,000 bu. of flax seed daily. The seven mills in the state are giving employment to full working forces on a full time and, in some cases, overtime schedule, and expect to continue on this basis indefinitely. It is stated that up to the present time, based on the production season, close to 23,000,000 bu. of flax seed has been marketed in that section, for use at the mills.

Financial

The statement of the New Jersey Zinc Co. for the year ended Dec. 31 shows net income of $6,405,643 after depreciation, taxes and interest charges, equivalent to $13.05 a share earned on $49,081,600 capital stock. This compares with $6,364,403, or $12.99 a share, on $48,981,600 stock in 1923.

The New York Stock Exchange has received notice from the Ajax Rubber Co., Inc., that holders of capital stock of record at close of business on Feb. 9 will be offered right to subscribe at $10 a share for capital stock of no par value to the extent of 3 shares of said stock for each 17 shares held.

The report of the Texas Gulf Sulphur Co. for the year ended Dec. 31 shows net income of $4,814,016 after expenses and federal taxes, equivalent to $7.58 a share earned on outstanding 635,000 shares of capital stock. This compares with $4,737,020, or $7.45 a share, in 1923.

The Glidden Co.'s plan to refund the first 8 per cent bonds, of which there were $2,867,500 outstanding Oct. 31, with an issue of 6 per cent bonds, has been approved by holders of prior preference stock, more than the necessary 75 per cent having assented. The annual sinking fund on the prior preference, which could not be paid until the 8 per cent bonds had been retired, will now become operative.

The National City Co. is offering an issue of $15,000,000 Magnolia Petroleum Co. serial 4½ per cent gold debentures, maturing $1,500,000 annually 1926 to 1935 inclusive, at prices to yield from 4.25 per cent to 4.90 per cent. This issue will constitute the sole funded indebtedness of the company upon the redemption of its present $8,500,000 first mortgage 6 per cent bonds, provided for from proceeds of present financing.

Trade Notes

According to reports to the Department of Commorce, a royal decree published at Madrid on Jan. 22 provides for the unrestricted exportation of olive oil from Spain after Feb. 1 without the payment of duty.

Questions involved in the establishment of a standard for opaque rosin are to be considered at a public hearing on May 4 at the Bureau of Chemistry in Washington. The existing standards do not cover this grade of rosin.

Harry Hudler, president and treasurer of the Parrott Varnish Co., of Bridgeport, Conn., died last week at his home in Mount Vernon, N. Y. Mr. Hudler formerly was connected with Berry Brothers and had acted as New York manager for 29 years.

The Federal Trade Commission has issued an order requiring the T. M. Sayman Products Co. of St. Louis, Mo., to discontinue the use of unfair methods of competition in the distribution and sale of its products, particularly its soaps. The respondent admits the charges of the complaint and agrees with the commission as to a statement of facts upon which the order is based.

C. A. Barbour of Houston, Tex., has been elected president of the United Carbon Co. which was recently organized to merge nine carbon black companies operating in the Monroe, La., natural gas field. The assets of the companies involved are approximately $15,000,000. These companies are the Cosmos Carbon Co., Standard Carbon Co., Pelican Carbon Co., Central Carbon Co., Louisiana Gas Products Corp., Humphries Carbon Co., Magnolia Carbon Co., United Oil & Natural Gas Products Co. and the Consolidated Carbon Co., which was recently organ-ern fields may be included in the new organization.

Gas Appliance Laboratory Planned

The American Gas Association has just announced arrangements for its applicance-testing laboratory, which is to be located at one of the plants of the East Ohio Gas Co., at Cleveland. The staff of the laboratory has not been selected, but it is expected that it will include chemists, utilization engineers and others, so that the association can conduct research and make reports on various gas-burning applicances submitted for test by various manufacturers.

Plant for Reclaiming Arsenic

The American Smelting & Refining Co. has work under way on a new plant at its properties at San Luis Potosi, Mexico, designed for the reclaiming of arsenic ores roasted in the smelter at this location. The new plant is expected to develop large production, and is estimated to cost more than $500,000. An expansion and improvement program will be carried out at the local works to cost about $2,500,000, including the arsenic reclamation plant.

Market Conditions

Recent Increase in Production of Chemicals Maintained

Contract Withdrawals Large Enough to Prevent Accumulations at Works—Spot Trading Along Moderate Lines

SPOT trading in the chemical market is not especially active and the fact that consumers have not come in the market regularly for additional lots has given rise to reports of a slow trading movement. However, it is generally admitted that the increase in production of chemicals which marked the closing months of last year has been maintained and reports further agree that stocks are not accumulating at producing points. Hence it is evident that consumption, as measured by contract deliveries increased by the volume of current buying, is on a close parity with the increased scope of production.

The weighted index number for the week was 113.66 as compared with 114.15 for the preceding week. The lower level of prices was established largely as a result of lower metal markets with a consequent decline in values for the metal salts. Generally speaking, market prices for chemicals are steady. Producers of many chemicals have a large part of their output sold ahead and there is less incentive to grant price concessions. Imported chemicals also have maintained a steadier tone and competition from that source is no longer a factor in buyers' favor, except in a few cases.

Announcement has been made to the effect that prices for potash salts are to be continued on deliveries over the next 2 months. There have been different rumors about an advance in prices for these salts and the control which producers exercise over supplies gave some probability to the truth of such rumors. The knowledge that foreign sellers would make no immediate advance in price was favorably received by domestic consumers.

Reports have been current that the tariff investigation into chlorate of potash had reached a stage where a decision might be rendered in a short time. These reports also favor an increase in duty. Should this prove to be the case, an impetus would be given to domestic production with higher selling prices almost a certainty.

Acids

On the higher strengths of acetic acid there is competition from foreign producers and prices are irregular with a difference according to make and seller. The lower grades of this acid are in seasonal demand with no change in open quotations although large consumers have been favored on contract business. Importers of citric acid report a stronger tone abroad and spot holdings were quoted at an inside of 46c. per lb. which is the quotation of domestic crystals, with powdered at 47c. per lb. Tartaric acid is generally held at 27c. per lb. on spot but occasional sales have gone through fractionally lower. Domestic tartaric is held at

Lower Selling Prices for Tin Salts—Lead Pigments Decline One-Half Cent Per Lb.—Wood Distillation Chemicals Easy—Bichromates Continue Strong—Firm Market for Barium Chloride — Active Call for Soda Ash—Prussiates Irregular — Chlorate of Potash Shows Advancing Tendency

29c. per lb. Holders of oxalic acid have been offering freely and prices have been open to negotiation. Domestic grades are quoted at 10¼c. per lb. and upward. Lactic acid has been moving regularly with values well maintained. Higher prices for raw materials have had a strengthening effect on values for nitric acid but the greatest improvement is found in the reduction of stocks in sellers' hands and the close connection between consumption and production. This is also true of sulphuric acid with some sellers of the latter sold ahead for the season.

Potashes

Bichromate of Potash—While reports of buying interest both for home and foreign account have been encouraging, actual business is said to be moderate with small lot orders predominating. Sellers are in more accord regarding prices and up to 8¾c. per lb. is asked. The inside price is reported as 8¼c. per lb. with the latter not a general price.

Carbonate of Potash—Calcined 80-85 per cent has been kept in a firm position and offerings are still limited. Asking prices are on a basis of 6c. per lb. for spot and 5¾c. per lb. for shipments. On the 96-98 per cent material 6@6¼c. per lb. is the prevailing quotation. Hydrated 80-85 per cent met with a moderate inquiry with holders asking 5¼c. per lb. for spot and shipments.

Caustic Potash—A firm tone underlies this market. Exporters in foreign markets are reported to have strengthened their position, although they are not in control of all supplies. For prompt shipment from abroad 7¼c. per lb. is asked and spot material has ranged from 7¼c. to 7¾c. per lb. according to seller and quantity. Domestic caustic is offered at 7¼c. per lb. at works, in large lots.

Chlorate of Potash—Interest in chlorate has been heightened by reports that a recommendation for an increase in duty soon would be made. Naturally this would be a bullish factor on values and the market has held a firm position. Demand is not active, as many consumers are covered ahead, but spot chlorate was held at 7@7¼c. per lb. for imported. Shipments were quoted at 7c. per lb.

Prussiate of Potash—Yellow prussiate of potash has held an irregular course with quiet demand bringing out some pressure from holders of stocks. There were reports that 17¾c. per lb. could be done in some quarters. Spot prussiate was generally quoted at 18@18¼c. per lb. Red prussiate was quiet with values around 38c. per lb.

Sodas

Bichromate of Soda — Deliveries against contracts are taking up the greater part of production. Most large consumers are covered ahead and this accounts for the lessened competition among sellers. Some contracts were taken at low prices and producers are content to let values go up so as to obtain a higher average on their total sales. Sales of moderate sized lots of bichromate have been made at 6¾c. per lb. On larger amounts lower prices can be found and 6¼c. per lb. is indicated as the lowest figure although the latter figure is not a general offering price. Chrome ore was reported as quiet with prices at $20 per ton for Indian, $22 per ton for Rhodesian, and $24 per ton for New Caledonian.

Caustic Soda—Production is reported to be large and contract deliveries to be larger in volume than for the corresponding period of last year. In general prices are established on a fixed basis but the stability of the market is upset by reports of occasional sales for domestic account at prices below the general quotation. The contract figure is steady at $3.10 per 100 lb. Export prices are difficult to place at a specified figure and range from $2.90 to $3.10 per 100 lb. Flake and ground caustic is maintained at $3.50 per 100 lb. in carlots, at works.

Fluoride of Soda—Open quotations for spot material were on a basis of 9¼c. per lb. and upward but the tone was hardly steady and sales are said

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	113.66
Last week	114.15
Feb., 1924	121.05
Feb., 1923	125.59

Declines in lead pigments and tin salts combined with easy markets for arsenic, prussiates, and wood distillation chemicals offset the generally firm position of heavy chemicals and the weighted index number for the week declined to 113.66, a reduction of 0.49 for the period.

to have been made under the inside quotation. Demand is not active and buyers are taking only when in need of supplies. Forward positions are offered at 9c. per lb.

Nitrate of Soda—Spot nitrate has worked into a strong position and holders were asking $2.67@$2.68 per 100 lb. The rise in exchange has been a factor in strengthening the market both here and in primary points. Consumption of nitrate is along broader lines than last year with expansion reported in the fertilizer and acid industries.

Prussiate of Soda—It has been difficult to maintain prices at advanced levels. This not only reduced interest from consumers but weakened views of some sellers and as a result there has been a range in price according to seller. In some quarters as high as 11c. per lb. has been quoted as a firm price while other sellers have offered at 10½c. per lb. and intimated that this figure could be shaded materially on actual business.

Miscellaneous Chemicals

Acetone—This material has failed to recover in price and competition is holding values down to a point where buyers are favored. On carlot business the quotation is 10c. per lb., at works. Smaller lots range up to 12c. per lb. depending on quantity and package.

Arsenic—Producers of domestic arsenic are offering round lots at 5¾c. per lb. delivered. Demand is slow and production has been curtailed in order to work off stocks. Imported arsenic is largely nominal in the spot market with inquiry confined to small lots. Calcium arsenate is in large supply and is very dull. This accounts for the depressed condition of the arsenic market.

Barium Chloride—This material has been in rather limited supply and prices have been firm. Buyers have not been eager to take on stocks at the higher levels and this has taken the edge off values. Spot chloride is generally held at $68 per ton for imported but this might be shaded on firm bids. Domestic chloride is held at $70 per ton.

Formaldehyde—Producers are keeping prices on an unchanged basis but some concessions are said to have been given on small lot business. The inside quotation for carlots is 9c. per lb. and small lots range up to 9½c. per lb., although the latter figure does not appear to figure prominently in sales.

Tin Salts—While the average price for Straights tin was 58.250c. per lb. in January as compared with 56.245c. per lb. for December, a lower scale of prices has been named for February delivery of tin salts. Bichloride of tin is now quoted at 16c. per lb and tin crystals have declined to 39½c. per lb. Anhydrous tetrachloride of tin also shared in the downward movement and is offered at 32½c. per lb.

Alcohol

While the undertone in the market for denatured alcohol was not so firm, prices were repeated on the basis of 54@55c. per gal. for the special 190 proof, in drums, carload lots, f.o.b. point of production. Demand has been less active. Exports of pure and denatured alcohol in 1924 amounted to 312,187 gal., valued at $213,298.

There was a quiet and rather easy market for methanol and prices were unsettled. The open quotation for 97 per cent material held at 72c. per gal., in drums, carload lots. Exports of methanol in 1924 amounted to 640,637 gal., valued at $686,911.

Coal-Tar Products

Spot Offerings of Toluene and Solvent Naphtha Small—Benzene Outlook Improves—Ortho-toluidine Firmer

DISTRIBUTORS of benzene are in a position to make prompt deliveries of fairly large quantities, but the market underwent no further change so far as the trading basis is concerned. With petroleum products working into a more favorable position, producers of motor benzene look forward to moving all surplus stocks without resorting to price cutting. In the past week additional advances took place in crude petroleum, and the gasoline market has advanced fully 7c. per gal. from the recent low. Demand for toluene and solvent naphtha continues good and offerings for immediate shipment are comparatively small, some traders turning down business where prompt delivery is requested. Producers reported a firmer situation in ortho-toluidine. Pyridine was steady at the recent advance. Phenol was available in more than one direction at 23c. per lb., large drums, immediate delivery. Aniline oil was steady on a larger movement against contract requirements.

Total imports of coal-tar products in 1924 were valued at $20,119,024, which compares with $17,273,682 in the preceding year. The importations of creosote oil occupied a prominent place, amounting to $13,463,689. Imports of colors, dyes, stains, color acids and bases amounted to 3,433,946 lb., valued at $4,459,456, which compares with 3,265,022 lb., valued at $4,436,922, in 1923.

Aniline Oil and Salt—The recent drop in benzene had no influence upon the market for aniline oil. In fact producers reported a rather firm situation, based on reports to the effect that actual consumption has increased. The market held at 16c. per lb., drums extra, shipment from works. Aniline oil for red was nominally unchanged at 40c. per lb. Aniline salt was inactive and more or less unsettled at 22@23c. per lb.

Benzene—There was a better call for benzene at prevailing prices, but the situation did not change much in the past week. Production appears ample and producers are in a position to make immediate deliveries of round lots. The demand for motor grades will soon pick up and this should steady the situation, according to traders. The 90 per cent grade of benzene was offered at 21c. per gal., and the pure at 23c. per gal., tank cars, f.o.b. works.

Beta-Naphthol—Buying interest has improved, but this resulted in no apparent change in the situation. Producers offered technical material at 24@25c. per lb., the inside figure applying to round lots.

Creosote Oil—Higher prices obtained in the leading foreign markets, demand being good both for home and export requirements. Manchester quotes creosote at 7d. per gal., loose, works, with some holders disposed to withdraw from the market for the time being.

Naphthalene—Traders expect business to open up soon in both flake and ball, and this tends to support values. Demand at present is extremely slow and scattered parcels have sold at concessions. White flake was offered at 5@5½c. per lb., with ball naphthalene at 6@6½c. per lb. Chipped material was nominal at 4½c. per lb., with a possibility of shading this figure on a bid. Crude to import was unchanged at 2@2¼c. per lb., c.i.f. basis.

Ortho-toluidine—Demand has been sufficient to absorb surplus holdings and the market has steadied. First hands now quote 18c. per lb., an advance of 1c. for the week.

Phenol—Demand was described as routine only and offerings appeared on the market at 23c. per lb., immediate delivery, indicating that the situation underwent little change. On contract it was possible to obtain supplies at 22c. per lb. Most of the phenol produced is going to the manufacturers of phenolic resins.

Pyridine—Imports of pyridine in 1924 amounted to 671,117 lb., valued at $268,782. The market was steady at $4.25@$4.35 per gal., in sympathy with firm advances from abroad. Manchester quoted pyridine at 18s. 3d. per gal., works.

Solvent Naphtha—Spot supplies have diminished and the market closed firm, but quotably unchanged on the basis of 24c. per gal. for the water white, tank cars, works.

Toluene—Producers in some instances are behind in deliveries and this has created a rather firm situation on spot, scattered lots selling in outside channels at a premium. First hands still quote 26c. per gal. on tank cars, f.o.b. works.

Vegetable Oils and Fats

Cottonseed and Linseed Oils Steady—Heavy Importations of Palm Kernel Oil Expected—Soap Materials Lower

THE feature in the market was the continued weakness in all of the soap making fats and oils. Lower prices obtained for tallow, greases, palm kernel and palm oils, coconut oil and crude corn oil. Cottonseed oil was steady on support in the nearby positions from refiners. Linseed was not so firm at the close as earlier in the week. Liquidation brought out unsettlement in china wood oil. Norwegian interests offered whale oil in a large way, but the prices asked were considered too high. The heavy movement of palm kernel oil from abroad attracted widespread attention and, according to importers, the recent buying on the part of large soap makers will have an important bearing on the different soap making materials. Arrivals of palm kernel oil from abroad in the past 2 weeks amounted to more than 2,000 tons, and, it is estimated that the quantity contracted for will swell the total to at least 7,000 tons in the next month or so. Nearly all of the oil purchased was bought on a bulk shipment basis and the average price paid was 9¼c. per lb., c.i.f. New York and other Atlantic ports. Both English and German mills were sellers. With palm kernel oil coming forward in volume and actual production of animal fats suitable for soap making on the increase the situation favors buyers. Tallow sold at 9c. per lb., a new low for the movement. Because of the weakness in soap making materials the weekly index number declined 1.27 points.

Cottonseed Oil—Despite unsettlement in grains and other speculative commodity markets refined cottonseed oil held on a fairly steady basis, closing prices being from 8@10 points higher. Crude also was steady on renewed buying interest by refiners and some trading on the part of soap makers. In the Southeast crude sold at 9¼c. per lb., and in Texas at 9@9¼c. per lb., tank cars, f.o.b. mills. Prime summer bleachable oil was offered at 9½c. per lb., tank cars, Texas common points. P.S.Y. oil in New York settled with March at 11.14c. bid and May at 11.35c. bid. Refiners were buyers of nearby oil against sales of futures. There was improvement in cash business for oil as well as compound. Lard compound was offered at 13c. per lb., carload basis. Pure lard in Chicago settled on Thursday with cash quoted at 15.85c. per lb., and May at 16.37c. per lb. Pure lard held at a premium of more than 500 points over refined cottonseed oil. Stocks of lard on Feb. 1 in the Chicago district amounted to 49,746,039 lb., which compares with 20,345,742 lb. a month ago and 9,645,861 lb. a year ago.

Linseed Oil—At one time prices for linseed oil were 3c. per gal. higher, but lack of buying interest, together with unsettlement in the seed markets, forced crushers to come down to the old basis of $1.20@$1.21 per gal., February - March delivery. Several crushers were not over-supplied with oil and were inclined to advance prices on any bulges in seed. There was no important change in the seed outlook. Advices from the Argentine were conflicting, but most traders were inclined to credit reports of a smaller yield than that indicated by the government in its recent forecast. Buying of seed on the part of crushers was not active. European traders have been holding aloof. Buenos Aires quoted February seed at $2.53¾ per bu. Duluth quoted February seed at $3.15½ per bu., with May at $3.16½ and July at $3.13. Despite the larger domestic yield, receipts of seed at the 2 northwestern terminals so far this season, amounting to more than 26,000,000 bu., stocks are not large.

Imports of Coconut Oil Gain in 1924

Official returns covering importations of vegetable oils in 1924 reveal that the movement of coconut oil into this country made substantial gains. Arrivals of palm, linseed, soya and china wood oils were smaller than in 1923. Import statistics for the past 2 years follow:

	1924	1923
China wood, lb.	81,587,854	87,291,675
Coconut, lb.	222,793,441	181,882,149
Olive, edible, lb.	76,186,446	77,190,457
Olive foots, lb.	24,678,006	*
Olive, den't'd, lb.	7,239,630	*
Palm, lb.	101,779,802	128,494,679
Palm kernel, lb.	4,747,597	
Peanut, lb.	15,394,836	8,008,622
Rapeseed, gal.	2,314,944	2,124,330
Linseed, lb.	13,247,190	43,096,714
Soya bean, lb.	9,125,158	41,679,110
Other veg. oils, free, lb.	10,984,930	17,769,735

* In 1923 imports of denatured olive oil and foots, combined, amounted to 5,413 938 gal.

At Minneapolis the stocks of flaxseed on Feb. 1 amounted to 433,755 bu., which compares with 409,521 bu. on the corresponding date a year ago.

China Wood Oil—Liquidation on the part of one importer resulted in sales as low as 13c. per lb., tank cars, Pacific coast, but later 13¼c. appeared to be the inside price. In New York spot oil sold down to 14¼c. per lb., in bbl.

Coconut Oil—Liberal offerings of competing oils caused prices to weaken. On the Pacific coast Manila oil sold in bulk for future shipment at 9¼c. per lb. Tank cars sold at 9⅜c., February-March-April shipment from the coast. In New York prompt Ceylon type oil was offered at 9⅜c. per lb., tank car basis.

Corn Oil—Crude oil sold at 10c. per lb., tank cars, f.o.b. Chicago.

Palm Kernel Oil—There were offerings at 9⅜c. per lb., in casks, nearby shipment from abroad. Bulk oil was nominal at 9¼c., c.i.f. basis.

Palm Oils—Lagos oil closed at 9c. bid and 9¼c. asked, shipment from Africa. Niger was nominal at 8¼c. per lb., shipment from the West coast.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1913-14

This week	153.04
Last week	154.31
Feb., 1924	141.05
Feb., 1923	131.71

Soap making oils and fats were weak, lower prices prevailing for coconut, palm kernel, palm, tallow and greases. Cottonseed oil steadied on buying for refiners, while linseed ruled firm in sympathy with the seed markets. The index number, however, declined 1.27 points.

Whale Oil—Norwegian interests offered crude whale oil on a large scale on the basis of 8¾c. per lb. for the No. 1 and No. 2 grades, combined, basis c.i.f. Atlantic ports. According to private advices shippers stood ready to supply 12,000 tons. Total importations of crude whale oil in 1924 amounted to 5,074,271 gal., valued at $2,515,325.

Tallow, Etc.—Sales of extra quality tallow took place at 9c. per lb., a decline of ¼c. for the week. Yellow grease declined to 8¼c. per lb. Oleo stearine sold at 10¼c. per lb., a drop of ¼c.

Miscellaneous Materials

Antimony—White oxide of antimony, Chinese, 99 per cent, was advanced to 16@16¼c. per lb. The metal closed firm at 18@18¼c. per lb. on Chinese brands, and at 20c. per lb. on Cookson's "C" grade. Chinese needle, lump, 10c. per lb. Standard powdered needle, 200 mesh, 11½@13c. per lb.

Barytes—Water ground and floated, bleached, unchanged at $23 per ton, f.o.b. St. Louis. Water ground, 300 mesh, bags included, $22 per ton, Charlotte, N. C. Crude barytes, $7@$8 per ton, f.o.b. mines. In Canada crude 94@96 per cent $8 per ton, f.o.b. mine. Demand good and undertone steady.

Glycerine—Sales of crude soap lye reported at 12¼c. per lb., loose, f.o.b. point of production Middle West, a decline of ¼c. Dynamite nominally unchanged at 18½@18¾c. per lb. Chemically pure steady at 19c. per lb., in drums, New York. Imports of crude glycerine in 1924 amounted to 15,927,701 lb., which compares with 15,142,802 lb. in 1923.

Lead Pigments—The recent decline in the metal forced corroders to issue a lower schedule of prices for the different lead pigments, the reduction amounting to ¼c. per lb. Business was not active, but practically up to normal for this season of the year. Standard dry white lead settled at 11¼c. per lb., in bbl., carload lots, with the sublimed at 11c. per lb. Litharge was quoted at 12¾c. per lb. Orange mineral was lowered to 16¼c. per lb.

Zinc Oxide—There was no important change in the general situation and prices for the American and French process descriptions of zinc oxide were repeated. Demand has improved and the undertone remains fairly steady. American process lead free held at 7⅞c. per lb., carload basis.

Imports at the Port of New York

January 30 to February 5

ACIDS—Carbolic—5 cs. solid, Liverpool, Monsanto Chemical Works. **Formic**—156 dr., Hamburg, A. Klipstein & Co. **Oxalic**—20 csk., Hamburg, A. Klipstein & Co.; 20 csk., Hamburg, Seaboard National Bank; 35 csk., Antwerp, Kachurin Drug Co.; 35 csk., Antwerp, Pacific Chemical Co. **Salicylic**—11 cs., Antwerp, Order. **Tartaric**—125 csk., Rotterdam, W. Benkert & Co.

ALCOHOL—20 bbl. isopropyl, Hamburg, East River National Bank; 59 bbl. denatured, Aguadilla, Olivett Distilling Co.; 60 csk. butyl, Rotterdam, Kuttroff, Pickhardt & Co.; 62 dr. butyl, Rotterdam, H. A. Metz & Co.; 9 dr. do., Rotterdam, Order.

AMMONIUM BROMIDE — 2 cs., Hamburg, Order.

AMMONIUM CARBONATE — 13 cs., Liverpool, Brown Bros. & Co.

ANTIMONY SULPHURET — 250 cs., Bordeaux, Heemsoth, Basse Co.

ANTIMONY OXIDE—50 bg., Hamburg, A. Klipstein & Co.

ARSENIC—167 bbl., Tampico, American Smelting & Refining Co.

BARIUM CARBONATE—500 bg., Rotterdam, E. Suter & Co.

BARIUM SUPEROXIDE—46 kegs, Rotterdam, W. A. Brown & Co.; 31 kegs, Rotterdam, Mallinckrodt Chemical Works.

BARYTES — 447,500 kilos, Rotterdam, Ore & Chemicals Corp.; 100 bg., Bremen, J. Lee Smith & Co.; 20 csk., Hamburg, A. Hurst & Co.

BISMUTH — 39 cs., London, Chemical National Bank.

CALCIUM CHLORIDE—107 dr., Hamburg, E. Suter & Co.

CASEIN—417 bg., Buenos Aires, Bank of America; 834 bg., Buenos Aires, Order.

CHALK—750 bg., Antwerp Order; 500,000 kilos crude, Dunkirk, American Exchange National Bank; 200 bg. and 113 bbl., Antwerp, National City Bank; 400 bg., Antwerp, Brown Bros. & Co.; 500 bg., Antwerp, Dershaw & Coulson.

CHEMICALS—100 cs., Havre, Order; 10 bbl., Hamburg, Roessler & Hasslacher Chem. Co.; 95 csk., Hamburg, Pfaltz & Bauer; 10 cs., Rotterdam, Alpers & Mott; 285 cs., Rotterdam, Order; 165 csk. and 40 cs., Rotterdam, Roessler & Hasslacher Chemical Co.; 45 csk., Rotterdam Order; 77 csk., Rotterdam, A. Klipstein & Co.; 27 bbl., Bremen, Stanley Doggett Co.; 126 dr., Middlesbrough, Order; 25 bbl., Hamburg, Dissosway Chemical Co.

CHROME ORE—1,500 tons, Beira, E. J. Lavino & Co.

COAL-TAR DISTILLATE—94 dr., Liverpool, Order.

COAL-TAR INTERMEDIATES — 8 dr. orthocresol, Monsanto Chemical Works.

COLORS—5 csk., Antwerp, Irving Bank-Col. Trust Co.; 18 csk., Havre, Reichard-Coulston, Inc.; 54 csk. ultramarine blue, Hull, Van Oppen & Co.; 20 csk., Hull, F. B. Vandegrift & Co.; 22 csk., Rotterdam, Grasselli Dyestuff Corp.; 54 pkg. aniline, Rotterdam, Kuttroff, Pickhardt & Co.; 4 csk., Rotterdam, Color Service Corp.; 25 pkg. aniline, Rotterdam, H. A. Metz & Co.; 8 csk. aniline, Genoa, Irving Bank-Col. Trust Co.; 4 csk. aniline, Naples, Order; 20 csk., Havre, Scott, Libby & Co.; 82 csk. earth, Bremen, Heller & Merz Co.; 82 csk. do., Bremen, American Express Co.; 40 csk. aniline, Antwerp, Geigy Co.; 20 csk. aniline, Antwerp, Order; 7 cs. aniline, Genoa, Irving Bank-Col. Trust Co.; 100 csk. venetian red, Liverpool, J. Lee Smith & Co.; 2 kegs vermilion, London, Pomeroy & Fisher.

COPPER SULPHATE—100 bbl., Hamburg, Order.

FLUORSPAR — 350 bg., Hamburg, Roessler & Hasslacher Chem. Co.

FUSEL OIL—8 csk., Hamburg, Order.

GLYCERINE — 10 dr. crude, Antwerp, Brown Bros. & Co.

GRAPHITE — 50 bg., Havre, International Ores & Metals Co.

GLAUBER SALTS—300 bg., Bremen, E. M. Sergeant Co.; 175 bg., Hamburg, Order.

GUMS—272 bg. copal, Antwerp, Chemical National Bank; 276 bg. copal, Antwerp, M. Philippeau; 68 bg. do., Antwerp, W. Schall & Co.; 38 bg. copal, Antwerp, Order; 103 bg. copal, Antwerp, Brown Bros. & Co.; 189 bg. do., Antwerp, Order; 910 bg. copal, Antwerp, Chemical National Bank; 544 bg. copal, Antwerp, Order; 93 bg. Copal, Antwerp, Order; 54 cs. copal, Singapore, Baring Bros. & Co.; 100 cs. damar, Batavia, Central Union Trust Co.; 100 cs. do., Batavia, Guaranty Trust Co.; 417 bg. arabic and 238 bg. kadaya, Bombay, Order.

IRON OXIDE — 30 csk., Hull, J. Lee Smith & Co.; 192 bbl., Malaga, Reichard-Coulston, Inc.; 40 bbl., Hull, L. H. Butcher Co.; 300 bbl., Malaga, C. J. Osborn & Co.; 177 bbl., Malaga, S. L. Libby Corp.; 147 bbl., Malaga, C. K. Williams & Co.; 200 bbl., Malaga, Order; 19 csk., Liverpool, L. H. Butcher Co.; 24 csk., Liverpool, Bank of America; 62 csk., Liverpool, J. A. McNulty.

Opportunities in the Foreign Trade

Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.

BENZOL for motors, automobiles and chemical purposes. Berlin, Germany. Purchase.—13,490.

CARBON BLACK. Hamburg, Germany. Agency.—13,508.

CHEMICALS, industrial. Rosario, Argentina. Agency.—13,444.

OIL CAKE, cottonseed and vegetable oils. Amsterdam, Netherlands. Agency.—13,500.

LITHOPONE — 400 csk., Antwerp, B. Moore & Co.; 600 csk., Rotterdam, B. Moore & Co.

MAGNESITE — 101 bbl., Rotterdam, Speiden, Whitfield Co.; 104 csk. and 250 bg., Rotterdam, Brown Bros. & Co.

MAGNESIUM CHLORIDE — 148 dr., Hamburg, A. Kramer & Co.; 90 dr., Hamburg, Brown Bros. & Co.; 233 dr., Hamburg, Order.

MANGANESE—2,538 bg., Antilla, H. S. Pridmore.

MANGROVE BARK — 370 bg., Cape Haitian, Order.

MINERAL WHITE—100 bg., Hull, Whittaker, Clark & Daniels.

MYROBALANS — 1,038 pkts., Calcutta, National City Bank; 500 pkts., Calcutta, Standard Bank of South Africa; 1,731 bg., Bombay, Order.

OCHER—134 csk., Marseilles, Reichard-Coulston, Inc.; 87 csk., Marseilles, J. Lee Smith & Co.

OILS—61 csk. and 2 bbl., Halifax, Cook & Swan Co.; 300 csk., St. Johns, National Oil Products Co.; 100 csk., St. Johns, R. Badcock & Co. **Linseed**—100 bbl., Hull, Order; 150 bbl., Antwerp, Order. **Olive foots** (sulphur oil)—200 bbl., Catania, E. M. Sergeant & Co.; 300 bbl., Patras, Order; 300 bbl., Bari, National City Bank; 200 bbl., Bari, Order; 500 bbl., Lisbon, Heidelbach, Ickelheimer & Co. **Palm kernel**—785 tons (in bulk), Hull, Order; 90 bbl., Hamburg, Rayner & Stonington; 780 tons (in bulk), Hull, National Bank of Commerce; 785 tons, Hull, Order. **Palm**—168 csk., Burutu, Irving Bank-Col. Trust Co.; 545 csk., Liverpool, Guaranty Trust Co. **Rapeseed**—100 bbl., Hull, Balfour, Williamson & Co.; 200 bbl., Hull, J. C. Francesconi & Co.; 315 bbl., Hull, Order. **Seal**—10 csk., St. Johns, R. Badcock & Co.

OILSEEDS — **Castor** — 7,170 bg., Bahia, Baker Castor Oil Co.; 1,693 bg., Bahia, Seaboard National Bank; 1,700 bg., Bahia, National Bank of New York; 16,198 bg., Bombay, Order; 5,000 bg., Santos, Bank of New York & Trust Co.

POTASSIUM SALTS — 402 dr. caustic, Hamburg, Roessler & Hasslacher Chemical Co.; 3,000 bg. muriate and 183,004 kilos manure salt, Hamburg, Potash Importing Corp. of America; 1,016 bg. nitrate, Hamburg, Kuttroff, Pickhardt & Co.; 81 dr. caustic, Hamburg, A. Klipstein & Co.; 20 bbl. prussiate, Hamburg, Roessler & Hasslacher Chem. Co.; 51 dr., permanganate, Hamburg, Order; 200 dr. chlorate, Hamburg, E. Suter & Co.; 14 csk. carbonate, Hamburg, Parsons & Petit; 61 dr. caustic, Hamburg, A. Klipstein & Co.; 100 bbl. nitrate, Hamburg, Order; 10 csk. prussiate, Hamburg, Order; 45 bbl. alum, Hamburg, Order; 10,305 bg. muriate, Antwerp, Societe Commerciale des Potasses d'Alsace; 10 csk. caustic, Rotterdam, Manahan Chemical Co.; 7 cs. bromide, Vancouver, Order.

PUMICE—150 cs., Canneto Lipari, K. F. Griffiths & Co.; 8,413 bg., Canneto Lipari, Manufacturers Trust Co.; 572 bg., Canneto Lipari, Whittaker, Clark & Daniels.

PYRIDINE — 3 dr., Hamburg, Order; 3 dr., Hamburg, R. W. Greeff & Co.; 4 dr., Hamburg, Order.

QUEBRACHO—19,725 bg., Buenos Aires, Tannin Corp.; 975 bg., Buenos Aires, Irving Bank-Col. Trust Co.

SAL AMMONIAC — 35 bbl., Hamburg, Order; 145 csk., Rotterdam, Kuttroff, Pickhardt & Co.

SHELLAC—15 pkg., Bremen, Order; 47 cs., Marseilles, Jewitz & Sons; 29 cs., Rotterdam, C. F. Gerlach; 70 cs., Singapore, International Banking Corp.; 25 bg., Calcutta, Order.

SODIUM SALTS—80 kegs hyposulphite, Hamburg, Order; 130 dr. sulphite, Hamburg, C. S. Grant & Co.; 25 pkg. bromide, Hamburg, H. W. Peabody & Co.; 288 cs. hyposulphite, Marseilles, E. M. Sergeant & Co.; 447 bg., Marseilles, H. U. Kehoe; 4,976 bg. and 108 csk. nitrate, Brevik, Order; 132 dr. sulphate, Rotterdam, C. S. Grant & Co.; 50 kegs hyposulphite, H. A. Metz & Co.; 450 bg. nitrate, Rotterdam, Order; 30 csk. prussiate, Rotterdam, Order; 500 bg. phosphate, Antwerp, Order; 60 dr. hydrosulphite, Antwerp, E. Ritter; 154 bg. nitrate, Oslo, Order; 50 kegs hyposulphite, Liverpool, W. Mohrmann; 225 dr. cyanide, Liverpool, Order.

STRONTIUM NITRATE—73 csk., Rotterdam, Pfaltz & Bauer; 168 csk., Rotterdam, E. Suter & Co.

TALC — 500 bg., Bordeaux, C. B. Chrystal Co.; 300 bg., Bordeaux, Whittaker, Clark & Daniels; 1,000 bg., Bordeaux, Hammill & Gillespie; 200 bg., Bordeaux, E. M. & F. Waldo; 250 bg., Genoa, L. A. Salomon & Bros.

TALLOW—200 tcs., Vancouver, Order.

TANNING EXTRACT—30 csk., London, S. Saxe.

TARTAR—46 csk., Naples, Royal Baking Powder Co.; 18 csk., Naples, Tartar Chemical Co.; 10 csk., Naples, Lo Curto & Funk; 58 bg., Bordeaux, Tartar Chemical Co.; 100 bg., Marseilles, Royal Baking Powder Co.; 855 bg., Marseilles, C. Pfizer & Co.; 520 bbl., Tarragona, Harshaw, Fuller & Goodwin.

WAXES—9 bg. beeswax, Mayaguez, C. A. Philippi; 2 bg. do., Mayaguez, D. Steengrafe; 365 bg. carnauba, Ceara, Order; 112 bg. carnauba, Bahia, W. R. Grace & Co.; 6,120 bg. paraffine, Balikpapan, Asiatic Petroleum Co.; 25 bg. ozokerite, Trieste, Order; 14 cs. beeswax, Calcutta, Order.

WOOL GREASE—31 csk., Havre, Salomon Bros.; 90 bbl., Antwerp, Order.

ZINC OXIDE—220 bbl., Antwerp, Brown Bros. & Co.

Current Prices in the New York Market

For Chemicals, Oils and Allied Products

THESE prices are first-hand quotations in the New York market for industrial chemicals, coal-tar products and related materials used in the industries that produce

Dyes	**Paper and Pulp**
Paint and Varnish	**Petroleum**
Ceramic Materials	**Soap**
Fertilizers	**Explosives**
Rubber	**Food Products**
Sugar	**Metal Products**

Whenever available these prices are those of the American manufacturer. If for material f.o.b. works or on a contract basis, quotations are so designated. All prices refer to large quantities in original packages.

Industrial Chemicals

Acetone, drums, works	lb.	$0.10 –	$0.11
Acetic anhydride, 85 %, dr	lb.	.36 –	.38
Acid, acetic, 28%, bbl.	100 lb.	3.12 –	3.37
Acetic, 56%, bbl.	100 lb.	5.85 –	6.10
Acetic, 80%, bbl.	100 lb.	8.19 –	8.44
Glacial, 99½%, bbl.	100 lb.	11.01 –	11.51
Boric, bbl.	lb.	.10½–	.10½
Citric, kegs	lb.	.46 –	.46½
Formic, 85%	lb.	.10½–	.10½
Gallic, tech.	lb.	.45½–	.47
Hydrofluoric, 52%, carboys	lb.	.11 –	.12
Lactic, 44%, tech., light, bbl.	lb.	.13½–	.14
22% tech., light, bbl.	lb.	.06½–	.07
Muriatic, 18° tanks	100 lb.	.80 –	.85
Muriatic, 20°, tanks	100 lb.	.95 –	1.00
Nitric, 36°, carboys	lb.	.04 –	.04½
Nitric, 42°, carboys	lb.	.04½–	.05¼
Oleum, 20%, tanks	ton	16.00 –	17.00
Oxalic, crystals, bbl.	lb.	.10½–	.11
Phosphoric, 50% carboys	lb.	.07½–	.07¾
Pyrogallic, resublimed	lb.	1.55 –	1.60
Sulphuric, 60°, tanks	ton	8.50 –	9.50
Sulphuric, 60°, drums	ton	12.50 –	13.50
Sulphuric, 66°, tanks	ton	13.50 –	14.50
Sulphuric, 66°, drums	ton	17.50 –	18.50
Tannic, U.S.P., bbl.	lb.	.65 –	.70
Tannic, tech., bbl	lb.	.45 –	.50
Tartaric, imp., powd., bbl.	lb.	.27½–	.28
Tartaric, domestic, bbl.	lb.	.29 –	.30
Tungstic, per lb.	lb.	1.20 –	1.25
Alcohol, butyl, drums, wks.	lb.	.27 –	.30
Ethyl, 190 p'f. U.S.P., bbl.	gal.	4.89 –	.....
Denatured, 190 proof No. 1, special bbl.	gal.	.61 –	.....
No. 1, 190 proof, special, dr.	gal.	.55 –	.....
No. 1, 188 proof, bbl.	gal.	.65 –	.....
No. 1, 188 proof, dr.	gal.	.58 –	.....
No. 5, 188 proof, bbl.	gal.	.60 –	.....
No. 5, 188 proof, dr.	gal.	.54 –	.....
Alum, ammonia, lump, bbl.	lb.	.03½–	.04
Potash, lump, bbl.	lb.	.03 –	.03½
Chrome, lump, potash, bbl.	lb.	.05½–	.06
Aluminum sulphate, com., bags	100 lb.	1.40 –	1.45
Iron free, bags	lb.	2.40 –	2.45
Aqua ammonia, 26°, drums	lb.	.06½–	.06¾
Ammonia, anhydrous, cyl.	lb.	.28 –	.30
Ammonium carbonate, powd. tech., casks	lb.	.12 –	.12½
Nitrate, tech., casks	lb.	.09 –	.10
Amyl acetate tech., drums	gal.	3.25 –	3.50
Antimony oxide, white, bbl.	lb.	.16 –	.16½
Arsenic, white, powd., bbl.	lb.	.05½–	.05¾
Red, powd., kegs	lb.	.14½–	.15½
Barium carbonate, bbl.	ton	55.00 –	57.00
Chloride, bbl.	ton	66.00 –	68.00
Dioxide, 88%, drums	lb.	.17½–	.18
Nitrate, casks		.07½–	.08½
Blanc fixe, dry, bbl.	lb.	.03½–	.03¾
Bleaching powder, f.o.b. wks., drums, contract	100 lb.	1.90 –	.....
Spot, wks., drums	100 lb.	2.00 –	2.15
Borax, bbl.	lb.	.05 –	.05½
Bromine, cases	lb.	.47 –	.48
Calcium acetate, bags	100 lb.	3.00 –	3.05
Arsenate, dr.	lb.	.08 –	.08½
Carbide, drums	lb.	.05 –	.05½
Chloride, fused, dr. wks.	ton	21.00 –	.....
Gran. drums works	ton	27.00 –	.....
Phosphate, mono, bbl.	lb.	.06½–	.07½
Carbon bisulphide, drums	lb.	.06 –	.06½
Tetrachloride, drums	lb.	.07 –	.07¼
Chalk, precip.—domestic, light, bbl.	lb.	.04½–	.04¾
Imported, light, bbl.	lb.	.04½–	.05
Chlorine, liquid, tanks, wks.	lb.	.04½–	.....
Contract, tanks, wks.	lb.	.04 –	.....
Cylinders, 100 lb., wks.	lb.	.05½–	.07½
Cobalt, oxide, bbl.	lb.	2.10 –	2.25
Copperas, bulk, f.o.b. wks.	ton	16.00 –	18.00
Copper carbonate, bbl.	lb.	.17 –	17½
Cyanide, drums	lb.	.49 –	.50
Oxide, kegs	lb.	.16½–	.16¾
Sulphate, dom., bbl.	100 lb.	4.75 –	4.80
Imp. bbl.	100 lb.	4.62½–	.....
Cream of tartar, bbl.	lb.	.21 –	.21½
Epsom salt, dom., bbl.	100 lb.	1.75 –	2.00
Imp., tech., bags	100 lb.	1.35 –	1.40
U.S.P., dom., bbl.	100 lb.	2.10 –	2.35
Ether, U.S.P., dr concent'd.	lb.	.15 –	.16
Ethyl acetate, 85%, drums	gal.	.92 –	.95
Acetate, 99%, dr.	gal.	1.08 –	1.10
Formaldehyde, 40%, bbl.	lb.	.09 –	.09½
Fullers earth—f.o.b. mines	ton	7.50 –	18.00
Furfural, works, bbl.	lb.	.23 –	.....
Fusel oil, ref., drums	gal.	3.50 –	4.00
Crude, drums	gal.	2.60 –	2.80
Glaubers salt, wks., bags	100 lb.	1.15 –	1.40
Imp., bags	100 lb.	.85 –	.95
Glycerine, c. p., drums extra	lb.	.19 –	.19½
Crude 80%, loose	lb.	.12½–	.12¾
Hexamethylene, drums	lb.	.65 –	.67
Lead:			
White basic carbonate, dry, casks	lb.	$0.11½–	.....
White, basic sulphate, casks	lb.	.11 –	.....
White, in oil, kegs	lb.	.1297–	.....
Red, dry, casks	lb.	.1325–	.....
Red, in oil, kegs	lb.	.1428–	.....
Acetate, white crys., bbl.	lb.	.15½–	.....
Brown, broken, casks	lb.	.14½–	.....
Arsenate, white crys., bbl.	lb.	.16 –	$0.18
Lime-Hydrated, b.g., wks.	ton	10.50 –	12.50
Bbl., wks.	ton	18.00 –	19.00
Lump, bbl.	280 lb.	3.63 –	3.65
Litharge, comm., casks	lb.	.12½–	.....
Lithopone, bags	lb.	.06 –	.06½
Magnesium carb., tech., bags	lb.	.07 –	.08
Methanol, 95%, drums	gal.	.70 –	.72
97%, drums	gal.	.72 –	.74
Pure, tanks	gal.	.74 –	.76
drums	gal.	.78 –	.80
bbl.	gal.	.83 –	.85
Methyl-acetone, t'ks	gal.	.70 –	.....
Nickel salt, double, bbl.	lb.	.10 –	.....
Single, bbl.	lb.	.10½–	.....
Orange mineral, csk.	lb.	.16½–	.16½
Phosgene		.60 –	.75
Phosphorus, red, cases	lb.	.70 –	.75
Yellow, cases	lb.	.37½–	.40
Potassium bichromate, casks	lb.	.08½–	.08¾
Bromide, gran., bbl.	lb.	.40 –	.48
Carbonate, 80–85%, calcined, casks	lb.	.06 –	.06½
Chlorate, powd.	lb.	.07 –	.08½
Cyanide, drums	lb.	.47 –	.52
First sorts, cask	lb.	.08½–	.08½
Hydroxide (caustic potash) drums	lb.	.07½–	.07½
Iodide, cases	lb.	3.65 –	3.75
Nitrate, bbl.	lb.	.06 –	.07½
Permanganate, drums	lb.	.14½–	.14¾
Prussiate, red, casks	lb.	.38 –	.38½
Prussiate, yellow, casks	lb.	.18 –	.18¾
Salammoniac, white, gran., casks, imported	lb.	.05½–	.06
White, gran., bbl., domestic	lb.	.07 –	.07½
Gray, gran., casks	lb.	.08 –	.09
Salsoda, bbl.	100 lb.	1.20 –	1.40
Salt cake (bulk) works	ton	17.00 –	19.00
Soda ash, light 58% flat, bulk, contract	100 lb.	1.25 –	.....
bags, contract	100 lb.	1.38 –	.....
Dense, bulk, contract, basis 58%	100 lb.	1.35 –	.....
bags, contract	100 lb.	1.45 –	.....
Soda, caustic, 76%, solid, drums contract	100 lb.	3.10 –	.....
Caustic, ground and flake, contracts, dr.	100 lb.	3.50 –	3.85
Caustic, solid, 76% f.a.s. N. Y.	100 lb.	2.85 –	3.05
Sodium acetate, works, bbl.	lb.	.05 –	.05½
Bicarbonate, bulk	100 lb.	1.75 –	.....
Bichromate, casks	lb.	.06½–	.06½
Bisulphate (niter cake)	ton	6.00 –	7.00
Bisulphite, powd., U.S.P., bbl.	lb.	.04½–	.04¾
Bromide, bbl.	lb.	.41 –	.47
Chlorate, kegs	lb.	.06½–	.06½
Chloride	long ton	12.00 –	13.00
Cyanide, cases	lb.	.19 –	.22
Flouride, bbl.	lb.	.09 –	.09½
Hyposulphite, bbl.	lb.	.02½–	.02½
Nitrite, casks	lb.	.09 –	.09½
Peroxide, powd., cases	lb.	.23 –	.27
Phosphate, dibasic, bbl.	lb.	.03½–	.03½
Prussiate, yel. bbl.	lb.	.10½–	.10½
Salicylate, drums	lb.	$0.38 –	$0.40
Silicate (40°, drums)	100 lb.	.75 –	1.16
Silicate (60°, drums)	100 lb.	1.75 –	2.00
Sulphide, fused, 60-62%, drums	lb.	.02½–	.03½
Sulphite, crys., bbl.	lb.	.03½–	.03½
Strontium nitrate, powd., bbl	lb.	.09½–	.10
Sulphur chloride, yel drums	lb.	.04½–	.05
Crude	ton	18.00 –	19.00
At mine, bulk	ton	14.00 –	16.00
Flour, bag	100 lb.	2.25 –	2.35
Dioxide, liquid, cyl.	lb.	.08 –	.08½
Tin bichloride, bbl.	lb.	.16 –	.....
Oxide, bbl.	lb.	.61 –	.....
Crystals, bbl.	lb.	.39½–	.40
Zinc carbonate, bags	lb.	.12 –	.14
Chloride, gran., bags	lb.	.06½–	.07½
Cyanide, drums	lb.	.40 –	.41
Dust bbl.	lb.	.08 –	.08½
Oxide, lead free, bags	lb.	.07½–	.....
5% lead sulphate bags	lb.	.06½–	.....
French, red seal, bags	lb.	.09½–	.....
French, green seal, bags	lb.	.10½–	.....
French, white seal, bbl.	lb.	.11½–	.....
Sulphate, bbl.	100 lb.	3.00 –	3.50

Coal-Tar Products

Alpha-naphthol, crude, bbl.	lb.	$0.60 –	$0.62
Alpha-naphthol, ref., bbl.	lb.	.75 –	.80
Alpha-naphthylamine, bbl.	lb.	.35 –	.36
Aniline oil, drums	lb.	.16 –	.16½
Aniline salt, bbl.	lb.	.22 –	.23
Anthracene, 80%, drums	lb.	.65 –	.70
Anthraquinone, 25%, drums	lb.	.65 –	.67
Benzaldehyde U.S.P., tech., drums	lb.	.69 –	.71
Benzene, pure, tanks, works	gal.	.23 –	.....
Benzene, 90%, tanks, works	gal.	.21 –	.....
Benzidine base, bbl.	lb.	.75 –	.78
Benzyl chloride, ref. carboys	lb.	.35 –	.....
Benzyl chloride, tech., drums	lb.	.25 –	.....
Beta-naphthol, tech., bbl.	lb.	.24 –	.25
Beta-naphthylamine, tech.	lb.	.65 –	.70
Cresylic acid, 97%, drums	gal.	.59 –	.62
95-97%, drums, works	gal.	.55 –	.57
Dichlorbenzene, drums	lb.	.07 –	.08½
Dinitrobenzene, bbl.	lb.	.15 –	.16
Dinitrochlorbenzene, bbl.	lb.	.20 –	.21
Dinitrophenol, bbl.	lb.	.35 –	.40
Dinitrotoluen, bbl.	lb.	.18 –	.20
Dip oil, 25%, drums	gal.	.26 –	.28
H-acid, bbl.	lb.	.70 –	.74
Meta-phenylenediamine, bbl.	lb.	.90 –	.95
Monochlorbenzene, drums	lb.	.08½–	.10
Naphthalene, flake, bbl.	lb.	.05 –	.05½
Naphthionate of soda, bbl.	lb.	.60 –	.65
Naphthionic acid, crude, bbl.	lb.	.60 –	.62
Nitrobenzene, drums	lb.	.09 –	.09½
Nitro-naphthalene, bbl.	lb.	.25 –	.27
Nitro-toluene, drums	lb.	.13½–	.14
N-W acid, bbl.	lb.	1.05 –	1.10
Ortho-amidophenol, kegs	lb.	2.40 –	2.50
Ortho-dichlorbenzene, drums	lb.	.10 –	.11
Ortho-toluidine, bbl.	lb.	.18 –	.18½
Para-aminophenol, base, kegs	lb.	1.15 –	1.20
Para-dichlorbenzene, bbl.	lb.	.18 –	.18½
Para-nitraniline, bbl.	lb.	.65 –	.67
Para-nitrotoluene, bbl.	lb.	.40 –	.42
Para-phenylendiamine, bbl.	lb.	1.25 –	1.35
Para-toluidine, bbl.	lb.	.70 –	.75
Phenol, U.S.P., dr.	lb.	.23 –	.25
Picric acid, bbl.	lb.	.25 –	.26
Pitch, tanks, works	ton	27.00 –	30.00
Pyridine, imp., drums	gal.	4.25 –	4.35
Resorcinol, tech., kegs	lb.	1.30 –	1.40
Resorcinol, pure, kegs	lb.	2.00 –	2.25
R-salt, bbl.	lb.	.50 –	.55
Salicylic acid, tech., bbl.	lb.	.34 –	.36
Salicylic acid, U.S.P., bbl.	lb.	.35 –	.....
Solvent naphtha, water-white, tanks	gal.	.24 –	.25
Crude, tanks	gal.	.21 –	.22
Sulphanilic acid, crude, bbl.	lb.	.16 –	.18
Tolidine, bbl.	lb.	1.00 –	1.05
Toluidine, mixed, kegs	lb.	.30 –	.35
Toluene, tank cars, works	gal.	.26 –	.....
Toluene, drums, works	gal.	.31 –	.....
Xylidine, drums	lb.	.40 –	.42
Xylene, 5 deg.-tanks	gal.	.34 –	.36
Xylene, com., tanks	gal.	.24 –	.26

Naval Stores

Rosin B-D, bbl.	280 lb.	$8.35 –	$8.40
Rosin E-I, bbl.	280 lb.	8.45 –	8.50
Rosin K-N, bbl.	280 lb.	8.70 –	8.80
Rosin W.G.-W.W., bbl.	280 lb.	9.60 –	10.50
Turpentine, spirits of, bbl.	gal.	.95 –	.....
Wood, steam dist., bbl.	gal.	.82 –	.82½
Wood, dest. dist., bbl.	gal.	.72 –	.73
Pine tar pitch, bbl.	200 lb.	6.00 –	.....
Tar, kiln burned, bbl.	500 lb.	13.00 –	13.50
Rosin oil, first run, bbl.	gal.	.47 –	.48
Pine tar oil, com'l	gal.	.32 –	.....

Animal Oils and Fats

Degras, bbl.	lb.	$0.03½ –	$0.05½
Grease, yellow, loose	lb.	.08½ –	.08½
Lard oil, Extra No. 1, bbl.	gal.	.96 –	.98½
Lard compound, bbl.	lb.	.13 –	.13½
Neatsfootoil, 20 deg. bbl.	gal.	1.35 –	1.37
Oleo Stearine	lb.	.10½ –	.....
Oleo oil, No. 1, bbl.	lb.	.12½ –	.13
Red oil, distilled, d.p. bbl.	lb.	.11 –	.11½
Tallow, extra, loose works	lb.	.09 –	.09½
Tallow oil, acidless, bbl.	gal.	.92 –	.94

Vegetable Oils

Castor oil, No. 3, bbl.	lb.	$0.17 –	$0.17½
Castor oil, No. 1, bbl.	lb.	.17½ –	.17½
Chinawood oil, bbl.	lb.	.14½ –	.15
Coconut oil, Ceylon, bbl.	lb.	.11 –	.11½
Ceylon, tanks, N. Y.	lb.	.09½ –	.09½
Corn oil, crude, bbl.	lb.	.12 –	.....
Crude, tanks, (f.o.b. mill)	lb.	.10 –	.....
Cottonseed oil, crude (f.o.b. mill), tanks	lb.	.09½ –	.....
Summer yellow, bbl.	lb.	.11½ –	.11½
Linseed oil, raw, car lots, bbl.	gal.	1.21 –	.....
Raw, tank cars (dom.)	gal.	1.15 –	.....
Boiled, cars, bbl. (dom.)	gal.	1.23 –	.....
Olive oil, denatured, bbl.	gal.	1.18 –	1.22
Sulphur, (foots) bbl.	lb.	.09½ –	.09½
Palm, Lagos, casks	lb.	.09½ –	.....
Niger, casks	lb.	.08½ –	.....
Palm kernel, bbl.	lb.	.09½ –	.....
Peanut oil, crude, tanks (mill)	lb.	.11 –	.11½
Refined, bbl.	lb.	.16 –	.16½
Perilla, bbl.	lb.	.14½ –	.14½
Rapeseed oil, refined, bbl.	gal.	.91 –	.93
Sesame, bbl.	lb.	.15 –	.15½
Soya bean (Manchurian), bbl	lb.	.13 –	.....
Tank, f.o.b. Pacific Coast	lb.	.11½ –	.11½

Fish Oils

Cod, Newfoundland, bbl.	gal.	$0.63 –	$0.64
Menhaden, light pressed, bbl.	gal.	.72 –	.75
White bleached, bbl.	gal.	.74 –	.77
Crude, tanks (f.o.b. factory)	gal.	.55 –	.....
Whale No. 1 crude, tanks, coast	lb.	..... –	.....
Winter, natural, bbl.	gal.	.75 –	.76
Winter, bleached, bbl.	gal.	.78 –	.....

Dye & Tanning Materials

Albumen, blood, bbl.	lb.	$0.50 –	$0.55
Albumen, egg, tech, kegs	lb.	.90 –	.95
Cochineal, bags	lb.	.33 –	.35
Cutch, Borneo, bales	lb.	.04½ –	.05
Rangoon, bales	lb.	.13 –	.13½
Dextrine, corn, bags 100	lb.	4.72 –	4.77
Gum, bags 100	lb.	4.94 –	5.07
Divi-divi, bags	ton	42.00 –	43.00
Fustic, sticks	ton	30.00 –	35.00
Chips, bags	lb.	.04 –	.05
Gambier com., bags	lb.	.18 –	.19
Logwood, sticks	ton	25.00 –	26.00
Chips, bags	lb.	.02½ –	.03
Sumac, leaves, Sicily, bags	ton	175 00 –	180 00
Domestic, bags	ton	50.00 –	55.00
Starch, corn, bags 100	lb.	3.97 –	4.24

Extracts

Archil, conc., bbl.	lb.	$0.16 –	$0.19
Chestnut, 25% tannin, tanks	lb.	.01½ –	.02½
Divi-divi, 25% tannin, bbl.	lb.	.05 –	.05
Fustic, liquid, 42°, bbl.	lb.	.08 –	.09½
Gambier, liq., 25% tannin, bbl.	lb.	13½ –	.14
Hematine crys., bbl.	lb.	.14 –	.18
Hemlock, 25% tannin, bbl.	lb.	.03½ –	.04
Hypernic, liquid, 51°, bbl.	lb.	.12 –	.13
Logwood, crys., bbl.	lb.	.14 –	.15
Liq., 51°, bbl.	lb.	.07½ –	.08½
Osage Orange, 51°, liquid, bbl.	lb.	.07 –	.08
Quebracho, solid, 65% tannin, bbl.	lb.	.04½ –	.04½
Sumac, dom., 51°, bbl.	lb.	.06½ –	.06½

Dry Colors

Blacks–Carbongas, bags, f.o.b. works, contract	lb.	$0.06½ –	$0.08½
spot, bags	lb.	.08½ –	.12
Lampblack, bbl.	lb.	.12 –	.40
Mineral, bulk	ton	35.00 –	45.00
Blues–Prussian, bbl.	lb.	.35 –	.37
Ultramarine, bbl.	lb.	.08 –	.35
Browns, Sienna, Ital., bbl.	lb.	.05 –	.12
Sienna, Domestic, bbl.	lb.	.03 –	.03½
Umber, Turkey, bbl.	lb.	.04 –	.04½
Greens-Chrome, C.P.Light, bbl.	lb.	.30 –	.32
Chrome, commercial, bbl.	lb.	.11 –	.12
Paris, bulk	lb.	.24 –	.26
Reds, Carmine No. 40, tins	lb.	4.25 –	4.50
Iron oxide red, casks	lb.	.08 –	.12
Para toner, kegs	lb.	.95 –	1.00
Vermilion, English, bbl.	lb.	1.40 –	1.45
Yellow, Chrome, C.P. bbls.	lb.	.20 –	.22
Ocher, French, casks	lb.	.02 –	.03

Waxes

Beeswax, crude, Afr. bg.	lb.	$0.39 –	$0.39½
Refined, light, bags	lb.	.52 –	.53
Candellila, bags	lb.	.29 –	.30
Carnauba, No. 1, bags	lb.	.36 –	.37
No. 2, North Country, bags	lb.	.30 –	.31
No. 3, North Country, bags	lb.	.28 –	.29
Japan, cases	lb.	$0.16 –	$0.16½
Montan, crude, bags	lb.	.06 –	.06½
Paraffine, crude, match, 105-110 m.p., bbl.	lb.	.06½ –	.06½
Crude, scale 124-126 m.p. bags	lb.	.05½ –	.06
Ref., 118-120 m.p. bags	lb.	.06 –	.06½
Ref., 123-125 m.p., bags	lb.	.06½ –	.06½
Stearic acid, agle. pressed, bags	lb.	.14 –	.14½
Double pressed, bags	lb.	.14½ –	.14½

Fertilizers

Acid phosphate, 16%, wks.	ton	$7.50 –	$7.75
Ammonium sulphate, bulk f.o.b. works 100	lb.	2.75 –	.....
Blood, dried, bulk	unit	3.85 –	3.95
Bone, raw, 3 and 50, ground	ton	26.00 –	28.00
Fish scrap, dom., dried, wks.	unit	5.00 –	.....
Nitrate of soda, bags 100	lb.	2.67½ –	.....
Tankage, high grade, f.o.b. Chicago	unit	3.10 –	3.20
Phosphate rock, f.o.b. mines			
Florida pebble, 68-72%	ton	3.00 –	3.50
Tennessee, 75%	ton	6.50 –	6.75
Potassium muriate, 80%, bags	ton	34.55 –	.....
Sulphate, bags, 90%	ton	45.85 –	.....
Double manure salt, bgs.	ton	26.35 –	.....
Kainit, 14%, bgs	ton	10.25 –	.....

Crude Rubber

Para—Upriver fine	lb.	$0.34 –	0.34½
Upriver coarse	lb.	.26 –	.26½
Plantation—First latex crepe	lb.	.35½ –	.36
Ribbed smoked sheets	lb.	.35½ –	.35½

Gums

Copal, Congo, amber, bags	lb.	$0.08½ –	$0.10
East Indian, bold, bags	lb.	.14 –	.15
Manila, amber, bags	lb.	.14 –	.16
Damar, Batavia, cases	lb.	.28½ –	.28½
Singapore, No. 1, cases	lb.	.31 –	.31½
Singapore, No. 2, cases	lb.	.21 –	.21½
Kauri, No. 1, cases	lb.	.58 –	.64
Ordinary chips, cases	lb.	.21 –	.22
Manjak, Barbados, bags	lb.	.06 –	.12

Shellac

Shellac, orange fine, bags	lb.	$0.64 –	$0.65
Orange superfine, bags	lb.	.66 –	.67
Bleached, bonedry	lb.	.71 –	.73
T. N., bags	lb.	.62 –	.63

Miscellaneous Materials

Asbestos, crude No. 1 f.o.b. Quebec sh. ton		$325.00–	$400.00
Shingle, f.o.b., Quebec sh. ton		45.00 –	50.00
Cement, f.o.b., Quebec sh. ton		15.00 –	20.00
Barytes, grd., white, f.o.b. mills, bbl. net ton		17.00 –	17.50
Grd., off-color, f.o.b., Balt net ton		13.00 –	14.00
Floated, f.o.b., St. Louis, bbl. net ton		23.00 –	24.00
Crude f.o.b. mines, bulk net ton		7.00 –	8.00
Casein, bbl., tech. lb.		.12½ –	.13½
China clay (kaolin) crude, No. 1, f.o.b. Ga. net ton		6.50 –	8.00
Powd., f.o.b. Ga. net ton		12.00 –	15.00
Crude, f.o.b. Va. net ton		5.50 –	7.00
Ground, f.o.b. Va. net ton		10.00 –	20.00
Imp., powd. net ton		45.00 –	50.00
Feldspar, No. 1 f.o.b. N.C. long ton		6.50 –	7.25
No. 2 f.o.b. N.C. long ton		4.50 –	5.00
No. 1 gr'd. Me. long ton		19.00 –	20.00
No. 1 Can., f.o.b., mill, powd. long ton		25.00 –	.....
Graphite, Ceylon, lump, first quality, bbl.	lb.	.07 –	.07½
High grade amorphous crude	ton	15.00 –	35.00
Gum arabic, amber, sorts, bags	lb.	.13 –	.13½
Tragacanth, sorts, bags	lb.	.50 –	.55
No. 1, bags	lb.	1.15 –	1.20
Kieselguhr, f.o.b. Cal.	ton	40.00 –	42.00
F.o.b. N.Y.	ton	50.00 –	55.00
Magnesite, calcined	ton	35.00 –	42.50
Pumice stone, imp., casks	lb.	.03 –	.40
Dom., lump, bbl.	lb.	.06 –	.08
Dom., ground, bbl.	lb.	.03 –	.05
Silica, glass sand, f.o.b. Ind.	ton	2.00 –	2.25
Sand blast, f.o.b. Ind.	ton	2.25 –	3.50
Amorphous, 200-mesh, f.o.b. Ill.	ton	20.00 –	.....
Glass sand, f.o.b. Ill.	ton	2.00 –	2.25
Soapstone, coarse, f.o.b., Vt., bags	ton	7.00 –	7.50
Talc, 200 mesh, f.o.b., Vt., bags, extra	ton	10.50 –	.....
200 mesh, f.o.b., Ga.	ton	7.50 –	10.00
325 mesh, f.o.b. New York, grade A	ton	14.75 –	.....

Mineral Oils

Crude, at Wells

Pennsylvania	bbl.	$3.50 –	$3.60
Corning	bbl.	1.95 –	.....
Cabell	bbl.	1.90 –	.....
Somerset	bbl.	2.05 –	.....
Illinois	bbl.	1.87 –	.....
Indiana	bbl.	1.88 –	.....
Kansas and Okla. under 28 deg.	bbl.	.90 –	.....
California, 35 deg. and up	bbl.	1.65 –	.....

Gasoline, Etc.

Motor gasoline steel bbls.	gal.	$0.21 –	.....
Naphtha, V. M. & P. deod, steel bbls.	gal.	.19 –	.....
Kerosene, ref., Lima-Ind.	gal.	.13 –	.....
Burning, W.W. delivered, N.Y.	gal.	.08½ –	.....
Lubricating oils:			
Cylinder, Penn., filtered	gal.	.34 –	$0.35
Bloomless, 30@31 grav.	gal.	.25 –	.....
Paraffin, pale 885 vis.	gal.	.15½ –	.16
Spindle, 200, pale	gal.	.22 –	.22½
Petrolatum, amber, bbls.	lb.	.04 –	.04½
Paraffine wax (see waxes)			

Refractories

Bauxite brick, 56% Al_2O_3, f.o.b. Pittsburgh	1,000	$140–	$145
Chrome brick, f.o.b. Eastern shipping points	ton	48–	50
Chrome cement, 40-50% Cr_2O_3	ton	23–	27
40-45% Cr_2O_3, sacks, f.o.b. Eastern shipping points	ton	23.00	
Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks.	1,000	43–	46
2nd. quality, 9-in. shapes, f.o.b. wks.	1,000	36–	40
Magnesite brick, 9-in. straight (f.o.b. wks.)	ton	65–	68
9-in. arches, wedges and keys	ton	80–	85
Silica brick, 9-in. sizes, f.o.b. Chicago district	1,000	48–	50
9-in. sizes, f.o.b., Birmingham	1,000	45–	47
F.o.b. Mt. Union, Pa.	1,000	40–	42
Silicon carbide refract brick, 9-in.	1,000	1,180	00

Ferro-Alloys

Ferrotitanium, 15-18% f.o.b. Niagara Falls, ton		$200.00 –	.....
Ferrochromium, per lb. of Cr, 1-2% C.	lb.	.24 –	.....
4-6% C.	lb.	.11½ –	.....
Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid	gr. ton	115.00 –	.....
Spiegeleisen, 19-21% Mn.	gr. ton	32.00 –	33.00
Ferromolybdenum, 50-60% Mo, per lb. Mo.	lb.	1.80 –	2.00
Ferrosilicon, 10-12%	gr. ton	39.50 –	44.50
50%	gr. ton	72.00 –	75.00
Ferrotungsten, 70-80% per lb. of W	lb.	.90 –	.....
Ferro-uranium, 35-50%, of U, per lb. of U	lb.	4.50 –	.....
Ferrovanadium, 30-40%, per lb. of V	lb.	3.25 –	4.00

Ores and Mineral Products

Bauxite, dom. crushed, dried, f.o.b. shipping points	ton	$5.50 –	$8.75
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	20.00 –	22.00
C.i.f. Atlantic seaboard	ton	18.50 –	24.00
Coke, fdry., f.o.b. ovens	ton	4.75 –	5.00
Coke, furnace, f.o.b. ovens	ton	3.50 –	3.75
Fluorspar, gravel, f.o.b. mines, Illinois	ton	17.50 –	18.50
Ilmenite, 52% TiO_2 Va.	lb.	.01½ –	.....
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.42 –	.43
Manganese ore, chemical (MnO_2)	ton	70.00 –	80.00
Molybdenite 85% MoS_2, per lb. Mo S_2, N. Y.	lb.	.60 –	.70
Monazite, per unit of ThO_2, c.i.f., Atl. seaport	lb.	.06 –	.08
Pyrites, Span., fines, c.i.f. Atl. seaport	unit	.11½ –	.12
Pyrites, Span., furnace size, c.i.f. Atl. seaport	unit	.12 –	.....
Pyrites, dom. fines, f.o.b. mines, Ga.	unit	.12 –	.....
Rutile, 94@96% TiO_2	lb.	.12 –	.15
Tungsten ore, scheelite, 60% WO_3 and over	unit	9.50 –	9.75
Tungsten, wolframite, white, 60% WO_3	unit	9.00 –	9.10
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 –	3.75
Uranium oxide, 96% per lb. U_3O_8	lb.	12.25 –	12.50
Vanadium pentoxide, 76%	lb.	3.00 –	3.25
Vanadium ore, per lb. V_2O_5	lb.	1.00 –	1.25
Zircon, 99%	lb.	.06 –	.07

Non-Ferrous Metals

Copper, electrolytic	lb.	$0.14½ –	$0.14½
Aluminum, 98 to 99%	lb.	.27 –	.28
Antimony, wholesale, Chinese and Japanese	lb.	.18 –	.18½
Nickel, 99%	lb.	.31 –	.32
Monel metal	lb.	.32	
Tin, 5-ton lots, Straits	lb.	.57½	
Lead, New York, spot	lb.	.09½	
Zinc, spot, New York	lb.	.0785	
Silver (commercial)	oz.	.63½	
Cadmium	lb.	.60–	.62
Bismuth (500 lb. lots)	lb.	1.30–1	35
Cobalt	lb.	2.50–3.00	
Magnesium, ingots, 99%	lb.	.90–1.00	
Platinum, refined	oz.	117.00	
Mercury, 75 lb.	lb.	81.00–82.00	
Tungsten powder	lb.	.95–1.00	

Industrial Developments of the Week

New Construction and Machinery Requirements in the Process Industries

Some Opportunities This Week

Cement.....Richard City, Tenn.
Chemicals.....Indianapolis, Ind.
Chemicals..... Washington, Ga.
Copper.....Peru, S. A.
Enameling.....Memphis, Tenn.
Fireclay.....Amherst, N. S.
Galvanizing.....Guelph, Ont.
Gas.....Tampa, Fla.
Nickel..... Coniston, Ont.
Paint..... Columbus, O.
Paper.....Kalamazoo, Mich.
Rubber.....Fairfield, Conn.
Rubber.....Tonowanda, N. Y.
Silver.....Niagara Falls, Ont.
Steel.....Canton, O.
Sugar.....New York, N. Y.
Sweeping Compounds.....Everett, Mass.

New England

Mass., Everett—J. F. Herne, 32 Cambridge St., Charlestown, Mass. (Boston P. O.) manufacturer of sweeping compounds, awarded contract for the construction of 4 factories and an office building here, to Clarke & Lee, 77 Summer St., Boston, Mass.

Middle Atlantic

Md., Baltimore—The Pittsburgh Plate Glass Co., Frick Bldg., Pittsburgh, Pa., awarded contract for the construction of a 3½ story, 40 x 85 ft. addition, to plant, here, to Charles L. Stockhausen Co., Inc. Estimated cost $65,000.

N. Y., Brooklyn—American Sugar Refining Co., 117 Wall St., New York, is having plans prepared for extension to sugar refinery on South 2nd St. Private plans.

N. Y., New York—American Beet Sugar Company, 32 Nassau St., has purchased the plant and properties of the Northern Sugar Corporation, Minneapolis, Minn., with mill at Mason City, Ia., and the Minnesota Sugar Co., Chaska, Minn. Extensions and improvements will be made in the plants. Bond issue of $3,500,000 has been arranged for.

N. Y., Tonowanda—The Dunlop Tire and Rubber Corporation of America, has acquired the property of the Utica Spinning Co., Utica, N. Y., and will operate the plant as a division of its business.

South

Ga., Washington—Pope Manufacturing Co., Dublin, M. J. Dicks, Pres. plans to expend $25,000 for improvement to cotton seed oil mill here.

Fla., Tampa—Tampa Gas Co., 201 Madison St., plans the extension of plant and service. Improvements include additional storage for 2,600,000 cu.ft. gas, 20 mi. mains, etc. J. D. Shattner is engineer.

Tenn., Chattanooga—Southland Portland Cement Co., Volunteer Bldg., J. O. Parker, Pres., has acquired 9,000 acres in Cumberland County, and has work underway on the first unit of a three-kiln plant with capacity of 3,000 bbls. per day. Estimated cost $1,500,000.

Tenn., Memphis—Memphis Fender and Enamel Works, 55 South Fourth St., has leased part of building at 5 South Fourth St., as an addition to their plant.

Tenn., Richard City—Dixie Portland Cement Co., Chattanooga. R. Hardy, James Bldg., Chattanooga, Pres., plans to expend $25,000 for improvements to plant here.

W. Va., Huntington—International Nickel Co., 67 Wall St., New York, awarded contract for the construction of a 50 x 120 ft. plant, to the Austin Co., 217 Broadway, New York. Estimated cost $175,000. Private plans.

This page is of value not only as a machinery market but also as an index of the general activity and growth of the industries served by Chem. & Met. The reports are gathered by our regular correspondents who are instructed to verify every detail. Requirements for new machinery will be published here free of charge.

Middle West

Ind., Indianapolis—Eli Lilly & Co., 210 East McCarty St., awarded contract for the construction of a 5 story, chemical manufacturing plant, to Leslie Colvin, Indianapolis. Estimated cost $1,000,000. Complete equipment will be installed, including roller conveyors.

Mich., Kalamazoo—The Kalamazoo Paper Co. is arranging an appropriation of $1,000,000 for improvements and extensions to its plants, and additional equipment. F. M. Hodge is president.

O., Canton—Berger Manufacturing Co., operated by the United Alloy Steel Corporation, plans the construction of portion of works recently destroyed by fire, including 1 story, 50 x 200 ft. galvanizing works. Total estimated cost $175,000.

O., Columbus—Dean & Barry Paint Co., 296 N. Water St., paint manufacturers, plans to install one, 24 in. Crawley roller mill; two, 36 in. Day heavy lead mixers. R. S. McKay is purchasing agent.

West of Mississippi

Mo., St. Louis—Presstite Engineering Co. W. C. Ferguson, Pres., has acquired a 1 story, 50 x 150 ft. plant, at 4327 Duncan Ave., for the manufacture of presstite, a flexible asphalt joint, for use in connecting sewer pipe. Machinery will be installed.

Canada

N. S., Amherst—Canadian Fireclay Refractories, Ltd. P. Hickey, Pur. Agt., is in the market for complete quarrying equipment.

Ont., Coniston—The Mond Nickel Company, Ltd., has work underway on sulphuric acid plant, at its smelter here, as an extension of its metallurgical operations.

Ont., Guelph—Page Hersy Iron & Tube Co., plans to rebuild galvanizing plant, completely destroyed by fire. Complete new equipment will be installed. Estimated loss $15,000.

Ont., Niagara Falls—Oneida Community Co., Ltd., manufacturers of silver and plated ware, plans enlarging of plant, and installation of additional machinery. Estimated cost $100,000.

South America

S. A., Peru—Cerro de Pasco Copper Corporation, 15 Broad St., New York City, is having plans prepared for the construction of an experimental leaching plant. Company will purchase material and equipment and do all building. Estimated cost $200,000. Private plans.

Unverified

Tenn., Alton Park—Southern Cotton & Paper Co., M. Reynolds, pres., is having plans prepared for extensions to plant, including the installation of machinery in paper department, to double present output.

Mo., Kansas City—Kansas City Smelting Co., Guinotte and Park Aves., have purchased its present site, and plans extensive improvements, including the installation of equipment for the manufacture of white metal alloys. An 800-ton hydraulic press for the manufacture of pipe lead will be installed.

Incorporations

White Behr Consolidated Oil Co., Dover, Del., minerals, $3,000,000. (United States Corporation Co.)

Zimmerman Rubber Co., Del., manufacturing, C. R. Zimmerman, E. Ewall, E. C. Patterson. (Delaware Registration Trust Co.)

Allerdice Hide and Tallow Co., Saratoga Springs, N. Y., $10,000. C. E. Allerdice, S. B. Eddy, F. E. Dorsey. (Brackett & Eddy, Saratoga).

General Asbestos Corporation of America, Manhattan, N. Y., $30,000. S. F. and H. J. and M. M. Cohen. (C. H. Cohen, 111 Broadway, N. Y.)

Orange Paint Co., Brooklyn, N. Y., $20,000. C. C. Morton, F. Morton, W. C. Morton, 363 East 17th St., Brooklyn.

Camphor Products Corporation, Manhattan, N. Y. S. Sachararoff, T. B. Snow. R. A. Joffe. (Attorneys, Celler & Kray-shaar).

Hudson Brass Works, Brooklyn, N. Y., has filed a certificate in the office of the secretary of state, increasing its capital stock from $250,000 to $350,000.

Southland Chemical Co., Philadelphia, Pa., $262,500. (Corporation Guarantee and Trust Co.)

Ceres Products Co., Chicago, Ill., manufacturer of extracts, $50,000. (Capitol Trust Co., of Delaware).

Tampa Asbestos Co., Tampa, Fla., $25,000. J. F. Senour, Pres.; S. M. Gegar, V. Pres.; J. W. Barber, Jr., Secy.; J. B. Hardin, Treas.

Artic Chemical Co., Canton, O., $150,000. Fred and John Seller.

Potsdam American Oil Co., Potsdam, N. Y., $100,000. F. B. Woodruff, H. W. Fearl, R. E. Roberts. (Attorneys, E. A. Everett, Potsdam).

Safety Tube Co., Brooklyn, N. Y., rubber tires, $50,000. I. Traurman, E. E. Bernard, O. I. Mosser. (Attorney, O. E. Mosser, 44 Court St., Brooklyn).

Bay Shore Rubber Tire Works, Queens. $20,000. S. A. Pode, S. and R. Gellar. (Attorneys, D. Gellar, 231 Sutter Ave., Brooklyn).

H. G. Craig & Co., New York, paper, $1,000,000. A. and T. T. Miller, E. A. Westfall (Attorneys, Olvany, Eisner, and Donnelly, 292 Madison Ave.)

Seabreeze Laboratories, Inc., Portland, Me., cosmetics and toilet preparations, $100,000. M. F. Foster, South Portland; M. G. O'Neil, Portland; A. B. Farnham, D. F. Drew.

Great Eastern Chemical Polish Co., Inc., Boston, Mass., $10,000. L. Mitchel, Pres., H. Shapiro, 605 Massachusetts Ave., Treas., H. H. Engler, Secy.

S. S. Learnard Co., Boston, Mass., slaughtering and animal products, $50,000. H. H. Learnard, S. E. Horton, C. W. Hapgood, Brookline, Mass.

Superior Grinding Wheel Co., Waltham, Mass., abrasive materials, $50,000. W. R. Guild, I. B. Decker, R. Sanborn, Cambridge, Mass.

American Fuel and Clay Products Co., Dover, Del., developers of coal and oil lands, $5,000,000.

Concrete Interlocking Tile Corporation of Long Island, Wilmington, Del., cement, $100,000. (Colonial Charter Co.)

Louisiana Clay Products & Utilities Co., Dover, Del., clay, timber, and mineral lands, $500,000.

Alloy Brazing Laboratories, Inc., New York City, N. Y., manufacturer and mill supplies, $40,000. H. Thomas, Bloomfield, N. J.; P. Droescher, 336 Ridgewood Ave., Brooklyn; D. Wolf, 10227 85th St., Richmond Hill, N. Y. (Attorney, S. Graham, 217 Broadway).